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STERKFONTEIN APE-MAN PLESIANTHROPUS

By

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MEMOIR No. 4

PRETORIA

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Part I

Further Evidence of the Structure of the Sterkfontein Ape-Man PLESIANTHROPUS

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ROBERT BROOM, F.R.S. and J. T. ROBINSON

Part II

The Brain Casts of the Recently Discovered PLESIANTHROPUS SKULLS

by

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To

THE RIGHT HON. FIELD MARSHAL J. C. SMUTS, C.H., O.M., F.R.S.

At whose request the research was undertaken.

Part I

Further Evidence of the Structure of the Sterkfontein Ape-Man

PLESIANTHROPUS

by

ROBERT BROOM, F.R.S. and J. T. ROBINSON

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FURTHER EVIDENCE OF THE STRUCTURE OF THE STERKFONTEIN APE-MAN PLESIANTHROPUS

INTRODUCTION

IN 1924, THE FAMOUS TAUNGS SKULL was found by Mr. M. de Bruyn, and described by Prof. Raymond A. Dart in 1925, under the name *Australopithecus africanus*. But since then no further remains of this interesting higher Primate have been discovered.

The skull is that of a young being corresponding, in state of development, to that of a 5 or 6 year old human child, or a chimpanzee of perhaps 3 years. Dart's first description led to much controversy. He himself regarded Australopithecus as a primate somewhat intermediate between the higher anthropoids and man; and probably near to the ancestor of man. Others held that it was an anthropoid rather closely related to the chimpanzee and gorilla, and which, by a parallel development, had acquired a few human characters, but which was not on or near the human line. The dispute lasted for over 10 years; but as the skull was that of a child and no further remains had been discovered it seemed impossible to bring the scientific world to a definite conclusion; and the only thing to be done seemed to be to hunt for an adult skull.

In 1934, the senior author was appointed to a post in the Transvaal Museum; and in May, 1936, he started the search for an adult skull of Australopithecus in the cave deposits around Pretoria. It was manifest that, if he failed in the main quest, he was certain to find many interesting new Pleistocene mammals, as it was an almost virgin field. Within a few weeks he had discovered many new mammals, the most interesting of which was a giant baboon which he called *Dinopithecus ingens*. Then at the end of July he heard of the caves at Sterkfontein, and on 9th August visited them with two of Dart's students, Mr. G. W. H. Schepers and Mr. H. le Riche. On 17th August, an adult skull of a being allied to Australopithecus was discovered, which was later described as *Plesianthropus transvaalensis*.

During the latter part of 1936, and much of 1937 and 1938, numerous portions of skulls, teeth and bones of Plesianthropus were discovered; and in 1938 much of the skull of a different type was discovered at Kromdraai and named *Paranthropus robustus*.

In January, 1946, there was published a full account of all the discoveries of these South African "ape-men" that had been made in the previous ten years. General Smuts was much interested in the work and asked Broom to carry on the search, which had been largely stopped during the war.

In the first three months of 1947 work was carried on at Kromdraai. A very fine sabre-tooth tiger skull was found, and the skull of a new type of large baboon, but no further evidence of ape-men or anthropoids was found.

In April, 1947, we started operations at Sterkfontein near the spot where the type skull was found in 1936. As the lime here was of poor quality, no further commercial quarrying had been done, and it was hoped that we might find a mandible or some bones of the skeleton. Though we found no more of the type individual we soon discovered other remains quite as important.

On the 10th April, we found a very beautiful isolated upper canine of a male — considerably worn, and the isolated lower molar of probably a female.

But on 18th April, a blast broke open a large block of what had appeared to be rather barren bone breccia, and in this was found the perfect skull of a middle-aged or elderly female Plesianthropus, but without the mandible. The blast had broken the skull in two by a fracture right round about the widest part of the brain case. The skull was thus broken almost exactly as a human skull is when the top is sawn off to get out the brain. Each half was embedded in a fairly uniform lime deposit with masses of broken chert. The brain cavity was lined with a layer of crystalline lime deposit to a thickness of from 1/16 to about 3/8 of an inch. The whole of the base of the brain cavity appeared to be perfect.

We discovered, on June 24th, a nearly complete lower jaw of a large elderly male Plesianthropus with a few bones of the skeleton. This lower jaw has the left ramus perfect, except for displacement and damage of the condyle, and with the symphysis fairly well preserved. Much of the right ramus is also preserved, but it is badly crushed. All the teeth of the left side and the incisors in front are preserved.

On 1st August, we discovered a nearly perfect pelvis with much of a femur and a few vertebrae. And in the latter part of the year much of three more skulls. As the work is still being continued, and other remains may at any time be discovered, we might devote all our energies to collecting; but we think, owing to the great importance of the finds we have already made, that these should be described as soon as possible. No doubt if we wait for two or three years we shall have much more to report; but what we now have seems to be too important to be held up. The whole scientific world appears to be anxiously awaiting our new facts. We cannot afford to stop work at the Caves, and, if there are those who consider we ought to give more elaborate reports we hope they will be charitable in remembering that besides the explorations at the Caves the preparation of the specimens is a very delicate task, which takes up about three quarters of our time.

In the book which was published in 1946 by Broom and Schepers, descriptions were given of all finds that had been made up till 1942. But though this book runs to 272 pages with 18 plates and many text figures, some complaints have been made that it ought to have been larger. And though in the present work we give descriptions of the more important finds made in 1947 and 1948, we are fully conscious that the importance of the discoveries would justify the publication of a book at least twice as large as the previously published volume. But this would take two years to complete, and we consider that speedy publication is important.

Dr. Weidenreich, in 1937, published two large volumes on "The Dentition of *Sinanthropus pekinensis*" — 180 pages of text with XXXVI plates and 49 diagrams. He describes 147 teeth of Sinanthropus. It is truly a colossal work of the utmost importance. And he has published other large works on the skulls, brains, and skeletal remains of Pekin man. But this has been the work of years.

We in South Africa have collections which rival those of Chou-kou-tien. We have about 200 teeth of our Australopithecines, and they are quite as important as those from Pekin, and worthy of as large a Monograph as that by Weidenreich. We have 5 good skulls, and 8 imperfect ones, and we have more important remains of the skeleton than have so far been found in China. It will take years before all the material we now have can be adequately described; and all the time we are adding more and more to our knowledge of the South African fossil forms. Our caves have so far only been scratched. Thousands of caves and cave deposits have never been examined. So our present paper, which deals almost entirely with less than two year's work in one cave, will give some idea of the wealth of our deposits. Our paper, though far from complete, will give a good idea of the general structure of Plesianthropus. We give the facts and leave the scientific world to decide whether it is a variety of Chimpanzee, or a being that may be rather closely related to man, and possibly allied to his ancestor. But while we give all the facts we must be allowed to give what are our own very definite opinions.

THE SKULL OF PLESIANTHROPUS.

THE TYPE SKULL of *Plesianthropus transvaalensis,* found on 17th August, 1936, was moderately complete, but the maxillae were detached and much displaced, a considerable part of the back of the skull was missing, and the brain case had manifestly been crushed down on the base, probably about 10 mm. Owing to the unsatisfactory condition of the bones at the base of the skull, it was impossible to have this cleaned out satisfactorily, and as the contacts of the maxillae were lost, a good deal of restoration had to be done. Still the drawings given of the skull in "The South African Fossil Ape-Men" are not very unsatisfactory. We knew very little of the lower jaw in 1946, and the unworn lower male canine was put into what seemed its position. It is probable, however, that the canines are ground down against each other quite early, so that this adult skull, which is that of a female, was most unlikely to have had locking canines. Otherwise the figures do not require much alteration.

As has been already stated, we were successful in blasting out, on 18th April, 1947, a perfect skull from a spot only about three feet below that from which the type skull came. (See figs. 1—4). With this skull there was no mandible and no other bones of the skeleton, though all the matrix was searched within a radius of many feet.

The skull had the top part broken off by the blast and showed the interior of the brain case which was lined by lime crystals. After many weeks of work the matrix was removed from the outer sides of the skull, and most of the crystalline deposit from the interior has also been removed. Of course, owing to the delicate condition of the bone it has been thought necessary to leave a small part of the internal deposit to hold the skull together; and portions of matrix have been left to support the jugal arches; and the orbits have not been cleaned out as there would then be no support for the thin bones forming the floor of the front of the brain cavity. During preparation we were able to see much of the detail in the orbit. There has been scarcely any crushing. In the region of the front of the brain cavity the delicate bones show just a little, but they do not seem displaced more than about 2 mm. in any part.

The skull has lost all the teeth, and the few that were still in place when the being died must have fallen out before fossilisation. There is no reasonable doubt that the skull is that of a female, and as most of the sutures are closed she must have been no longer young. No sutures are seen on the face except those at the sides of the nasals, and some indication of that between the jugal and the frontal on the right orbital margin. On the top of the skull the coronal suture is completely closed, but its approximate position can be traced in much of its course by a slight indication of where it had been. The sagittal suture is also closed, but about half its course is clearly marked. The lambdoidal suture is also closed, and nothing can be seen of it on the outer side; but its position can be clearly traced on the inner surface of the brain wall.

On the other hand, the suture between the jugal and the squamosal is quite distinct; and the whole of the suture round the front of the squamosal, and between the

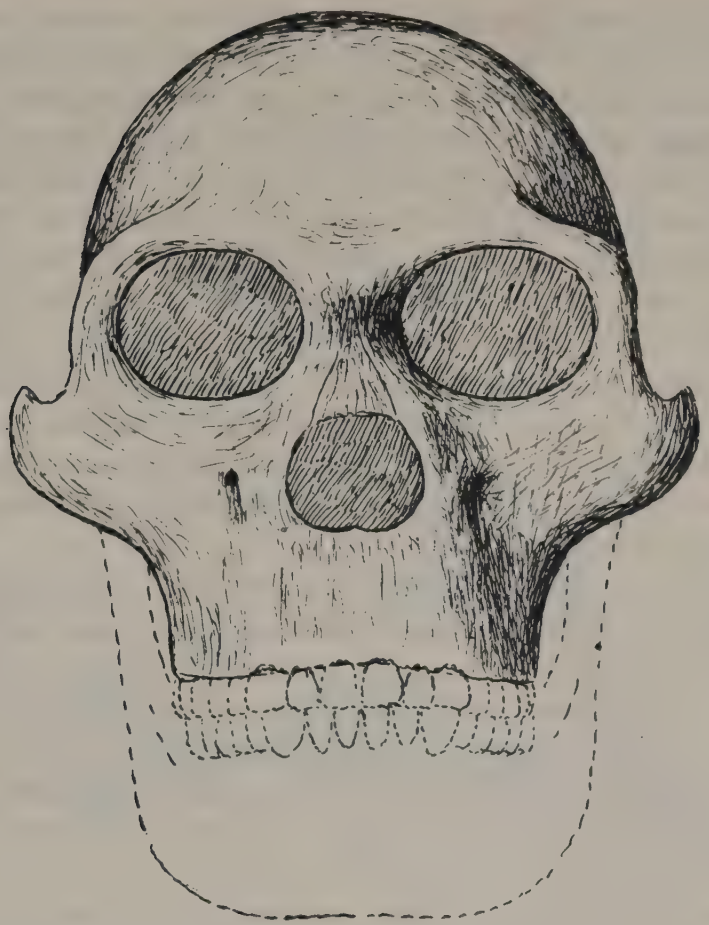

FIG. 1.—Front view of skull of *Plesianthropus transvaalensis* (Broom). (Skull 5). Drawn in Frankfort plane and in orthoprojection. Two-thirds natural size. The skull is that of a middle aged or elderly female.

squamosal and the parietal can be seen. On the base, a few of the sutures can still be traced, such as that between the occipital and the temporal, that between the tympanic and the squamosal, and the suture between the alisphenoid and the squamosal.

Figure 1, gives the front view of the skull drawn in the Frankfort plane. The greatest width of the skull across the temporal arches is 127 mm., and the height of the skull when arranged in the Frankfort plane, above the plane on which the back of the maxillary bones rest, is 126 mm. If the 3rd molars had been retained the height would have been about 138 mm.

The orbits are moderately large and a little broader than high. Each is about 34 mm. wide by 29.3 high, and the distance between the orbits is 16.3 mm. From the top of the nasals to the nasal spine the measurement is 46 mm., and the width of the nasal opening is 26 mm. The nasal spine, though small, is quite distinct.

The width of the brain case, in the region of about the middle of the squamosal, is 99 mm.

Above the orbits is a supraorbital ridge which is only moderately developed. Above the nose there is an irregularly rounded median boss which extends about 8 mm.

in front of the most depressed part of the nose. From this median boss the ridge passes outwards and very slightly backwards to the outer sides of the orbits, where it curves downwards and slightly backwards. Above, the orbital ridges pass upwards and backwards towards the upper part of the brow. Behind the median boss there is a slight concavity, but there is nothing like the deep transverse hollow seen in the Chimpanzee or in Sinanthropus. The condition in Plesianthropus is very much more like that in the Rhodesian skull, though there the ridges are greatly developed, and here only feebly. Of the three large living anthropoids the Orang comes nearest to the female Plesianthropus in the structure of the face, though the agreement is not very close.

The frontal region is flattened behind the ridges and farther back it becomes fairly evenly rounded. Behind the outer halves of the orbits the temporal fossae pass markedly inwards, and there is little doubt that the temporal muscles passed high up on the sides of the frontals as they do in the Chimpanzee. On the frontals the temporal lines approach as closely as about 45 mm.

The nasal bones are united, and together form a narrow isosceles triangle. Above the nasal opening they are about 17 mm. in width, and the measurement up to the nasion is about 24.4 mm. Though we have the nasals well preserved in the skull, and the impression of them on the counter slab, the lower border is a little doubtful. In the middle line they may be 2 mm. longer than this measurement gives.

The nasals are more like those of the Bushman and Korana, which have flat noses, than those of any of the anthropoids, though of the anthropoids the Orang approaches the most nearly.

The infraorbital foramina are large and single, the distance between them is 43.7 mm. The right foramen is 12.3 mm. below the orbit, and the left one 13.8 mm. From each foramen there is a groove running down the face towards the second premolar, but the groove is only well marked for half the distance.

The cheeks are broad, and moderately flat, and more like those of the Orang than those of the Chimpanzee or Gorilla. In man the cheeks, on passing downwards, usually recede forming the fossa, but in those early types of man such as Sinanthropus and Cyphanthropus the cheeks are not unlike those of Plesianthropus. In Paranthropus the two cheeks and the front of the snout all lie in almost one plane.

In front, and below the nose, the premaxillary region forms an almost flat surface a little wider than the nostril, and with the incisor teeth directed mainly downwards from its anterior third.

Above each canine there is a rounded angle which runs up towards the side of the nostril and divides the premaxillary anterior plane from the lateral part of the maxilla.

The base of the lateral part of the cheek arises from above the region of the 2nd molar roots. The jugal bone is placed much higher up than in the Chimpanzee or Orang and higher even than in man, and a little like the condition seen in some Gorillas.

The temporal arch is well developed. It is much longer than the arch in the Chimpanzee or Orang and far larger than even in such a huge human skull as Cyphanthropus. The measurement from the middle of the auditory meatus to the anterior end of the squamosal bone is in this Plesianthropus skull 68.5 mm. In a very large Korana skull it is 52.5 mm. In an Australian native skull — probably female — the measurement is 51 mm. In

Rhodesian man the measurement is only about 45 mm. In a male Chimpanzee it is only 42.5 mm., and in a large female Orang it is 54.6 mm. Even in a huge male Gorilla, with a skull about twice as large as this female Plesianthropus, the corresponding measurement is only 72.7 mm. In general structure the temporal arch is more like that of man than that of any of the anthropoids.

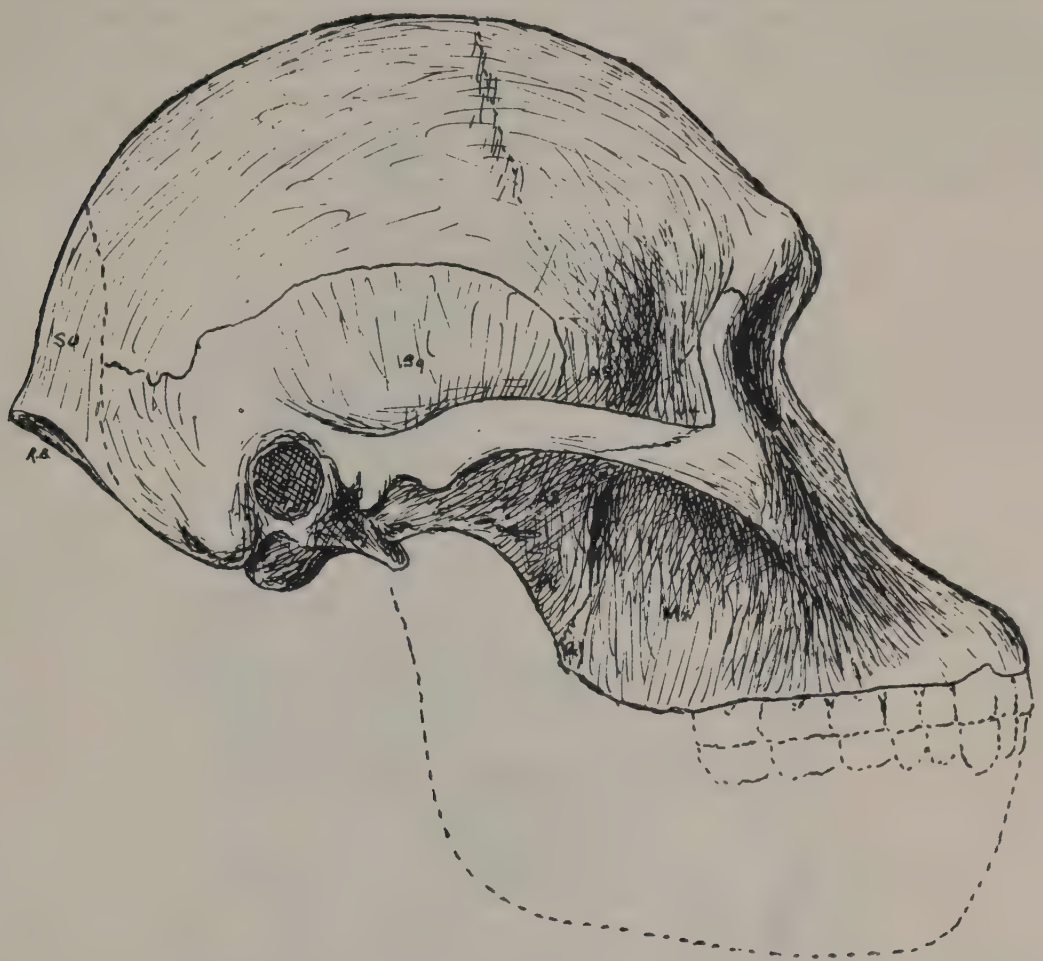

FIG. 2.— Side view of skull of *Plesianthropus transvaalensis* (Broom). Skull No. 5. Two-thirds natural size.

When the skull is viewed from the sides (fig. 2), the cranial vault is seen to be a long oval structure without any marked ridges except the occipital torus, which is low down, and the supraorbital ridges in front, which are not much above the general surface of the frontal. Though in general size and shape it is a little like the skull of the Chimpanzee, it differs in a number of important characters. The supraorbital ridges do not rise much above the curve of the frontals, the temporal arch is much more elevated and longer, the occipital condyle is in the plane directly below the ear opening, and the occipital crest is much lower down, and the whole brain case is more elevated.

The following are a few of the measurements. From the glabella to the occipital crest (greatest length of brain case) the measurement is 146.8 mm.; from the prosthion to the inion, 185 mm. As the exact spot of the bregma cannot be determined with certainty the height cannot be given to a mm., but it is very nearly 105 mm. The greatest breadth of the brain case is 99 mm. The following are the principal cranial indices — Cephalic

index 67.5, and the Height index about 71.5 mm. The skull is thus extremely dolichocephalic and orthocephalic. Neither of the indices differs from indices found in man.

The cranial capacity is about 482 cc. It cannot we think be more than a very few cubic centimetres more or less.

Various writers have referred to the brains of Australopithecus and Plesianthropus as comparable in size to those of Chimpanzees. This Plesianthropus brain is certainly a female brain, and in female Chimpanzees Zuckerman has shown that the range of variation is from 290 cc. to 455 cc., with an average of 365.8 cc. It is thus seen that this female Plesianthropus brain is larger than the largest known female Chimpanzee brain, and a third larger than the average female Chimpanzee brain.

FIG. 3.— Occipital view of skull of *Plesianthropus transvaalensis* (Broom). Skull No. 5. Two-thirds natural size. Skull is in the Frankfort plane. The lambdoidal suture cannot be traced on the outer surface but can be seen on the inner surface. The dotted line indicates its approximate position. Parts of the sagittal suture can be seen in the outer surface.

When the skull is viewed from behind (fig. 3), it is not very unlike that of the Chimpanzee or Orang except in one feature— the torus is situated at about the middle of the occipital bone instead of near to the lambdoidal suture as in these anthropoids. The whole brain case is seen to be considerably larger and relatively higher. In man the part of the temporal behind the mastoid process can hardly be said to form part of the occiput; but in the Orang and Chimpanzee the back part of the temporal forms much of the occiput. In this female Plesianthropus skull the condition is intermediate between that of the Chimpanzee and that of man, but more like that of the Ape, though there is no ridge of bone bounding the temporal region from the occipital.

The jugal arch differs considerably from that of the Chimpanzee apart from its much greater length. It curves upwards, and in general is much more like that of man.

It has a very well developed articular eminence, and behind the articular fossa there is a rather large postglenoid process. This process is peculiar in having a small secondary process behind it, and it is to this that the tympanic bone is attached. The condition is unlike that in any human skull we have seen, and even more unlike that of any Chimpanzee we have been able to examine. It is interesting to note that it differs considerably from the condition in Skull 8, where we have almost the human arrangement.

FIG. 4.— Base of skull of *Plesianthropus transvaalensis* (Broom). Skull No. 5. Two-thirds natural size.

Behind the auditory meatus there is a small mastoid process. On the right side, part has presumably been gnawed off, and a part of the tip has been inadvertently ground off. This latter injury reveals two large mastoid cells. In the drawing we give, the mastoid is restored as it probably was in life.

On the side of the skull is shown the suture between the squamosal and the parietal. This is not unlike that in man, and, unlike the sutures on the top of the skull, is still quite patent. It is continued back to meet the occiput, and in front it can be traced right down behind the alisphenoid.

Most of the boundaries of the alisphenoid can be clearly traced, and are as shown in figure 2. In the pterion region the front lower corner of the parietal is not clearly defined, but there is little doubt that the parietal articulates with the alisphenoid in typical human fashion.

The alisphenoid is well preserved, though part is hidden by the pieces of matrix left to support the jugal arch. It is more like that of man than that of the apes. The upper part probably articulates with the squamosal, the parietal, the frontal and the jugal as in man. Near the middle of the bone there is developed a well marked spine very similar to the human structure. In front of the alisphenoid there is a well developed sphenomaxillary fissure very like that of some human skulls, and a little less like that seen in the Chimpanzee. It is very unlike the condition in the Orang, and also unlike that of the Gibbon. The palatine has a long suture with the back part of the maxilla, and is wedged in between the maxilla and the pterygoid as in man.

The base of the skull is satisfactorily preserved (fig. 4). The palate is almost perfect, but as all the teeth are lost, and most of the molars apparently lost some time before death, any drawing of the molar alveolar region must be unsatisfactory. We have some evidence of the molar roots, but various sockets and possibly abscess cavities could not be cleaned out without the structure becoming lost.

The sockets of the incisors and canines are satisfactory, and those of the premolars on each side nearly satisfactorily preserved. There are clear indications of the positions of most of the roots of the molars, and they are as we have figured them.

The following are a few of the measurements:— Across the four incisors roots 28.5 mm.; between the outer sides of canine sockets about 42.5 mm. From the front of the canine socket to the back of the 3rd molar about 60 mm.

The length of the palate, from the prosthion to the posterior part of the palate in the middle line, is 73.5 mm. The greatest width of the palate, just behind the 3rd molars, is about 40 mm.; and the width, in the plane of the 2nd premolars is 31.5 mm. At the latter plane the height of the palate above the alveolar plane is 15 mm.

There is a large incisive foramen, the posterior border of which is situated 26 mm. behind the prosthion. In man, where the palate is usually a little smaller, the foramen is a little farther forward. The foramen is much larger than in the Orang or Chimpanzee. In the posterior part of the palate are two well marked fossae, and in the posterior and outer corner of each is a well developed rounded posterior palatine foramen. The distance between these two foramina is 25.5 mm. In the middle line between the foramina is a well marked median thickening of the palate. On each side of the median thickening, and partly behind the foramina, is a sharp ridge of bone directed downwards and forwards. We find a very similar condition in some Bantu skulls.

The palate is almost typically human, and not very like those of any of the anthropoids.

The base of the skull, from the foramen magnum to the internal nares, is essentially similar in structure in man and the higher anthropoids. In the old world monkeys and the Gibbon there are a number of characters which are more primitive. Plesianthropus, in all structures of the base of the skull, agrees essentially with man and the higher apes.

In man the basioccipital region is bent forwards towards the posterior nares: in the anthropoids the base of the skull is flatter. In Plesianthropus the condition is somewhat intermediate, but resembles rather more that of the anthropoids, though in some details it comes much nearer to man.

The basioccipital appears to be completely fused with the basisphenoid. A little in front of each condyle there is a distinct process on each side of the basioccipital. We find a similar process in some Bantu skulls, but it does not occur in Skull 8. It does not occur in any of the Chimpanzee skulls we have at hand. Between this process and the condyle is a deep depression in which lies the anterior condylar foramen.

On the outer side of the basioccipital lies the anterior part of the petrosal. Immediately outside the depression for the anterior condylar foramen is situated the depression in which lie the carotid canal and the jugular foramen. In man there is usually a single round depression in the anterior part of which is the carotid canal, and a ridge of bone divides this from the jugular foramen. In the Chimpanzee and Gorilla the carotid canal is usually in front of the rounded depression for the jugular. In the Orang the condition is more like that of man. In this Plesianthropus skull the structure is almost typically human. Some of the smaller old world monkeys, especially Colobus, come nearer to man in this character than do the higher anthropoids. The foramen magnum measures 28.3 mm. by 23.7 mm.

In front of the carotid foramen there is a well developed process passing, from the front side of the petrosal, downwards, forwards and inwards. This apparently is for the attachment of the levator palati muscle. A similar process is found in many human skulls, but it varies greatly. A somewhat similar process is also found in most higher primate skulls.

Outside the jugular depression, in a little pit, is the foramen for the VIIth nerve.

In front of the tympanic lies the glenoid cavity in the squamosal bone. There is a moderately deep transverse groove which, from the outer side, passes inwards and then somewhat backwards to the Glaserian fissure. There is considerable resemblance to the condition in the Chimpanzee and somewhat less to that of the Orang. The resemblance to the human condition is much more marked, the only important difference being that the tympanic does not continue on the postglenoid process, but is distinctly behind it. This condition must be variable in Plesianthropus, as in Skull No. 8 the structure is exactly as in man. The suture between the squamosal and the alisphenoid is, as in man, considerably outside the foramen ovale. In this it differs from the Chimpanzee condition. Immediately outside the foramen ovale is a very marked ridge of bone, and from the foramen there passes forwards a deep groove apparently for the buccal nerve. We can find nothing quite like it in any human or anthropoid skulls; but in two young Orangs there is an indication of a similar groove.

The pterygoid region agrees fairly well with the human condition, and less with the anthropoid structure. The pterygoid fossa is almost exactly as in many human skulls, and there is also a distinct scaphoid fossa as in many men.

The back part of the vomer, so far as displayed, is also quite manlike.

The foramen magnum is smaller than in man, as we should expect from the smaller brain, and the condyles and outer parts around it are much more human than ape-like.

On the right side of the occiput, as preserved, the jugular process has been gnawed off, perhaps by some small carnivore or rodent. As the whole occipital region is much less developed than in man, the part of the skull behind the foramen is relatively short, and it slopes much more upward than in man, but it does not slope nearly as much upward as in the Chimpanzee or other anthropoids, and is much flatter.

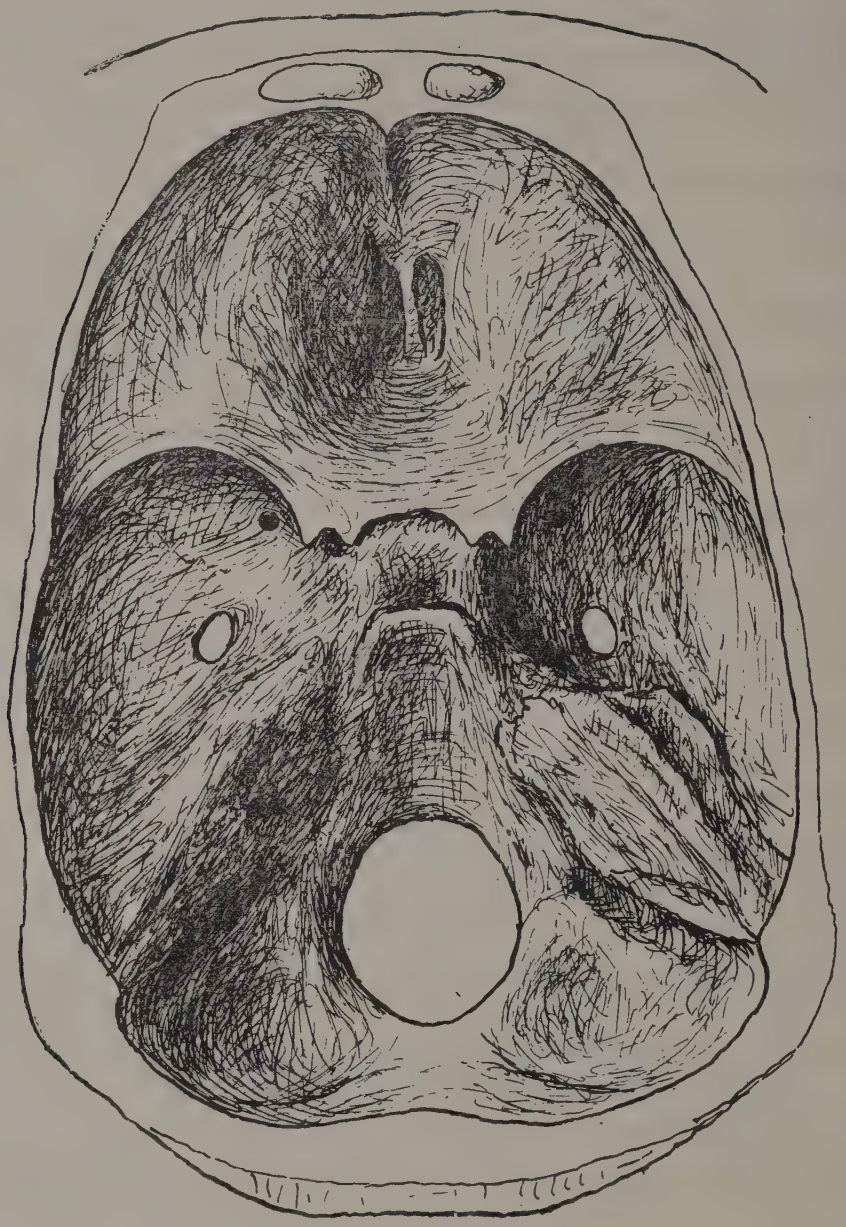

FIG. 5.— Base of skull (No. 5) of *Plesianthropus transvaalensis* (Broom). From above. Natural size.

The base of the interior of the skull is well shown (fig. 5). We have thought it advisable to leave a moderate sized patch of the crystalline lime material to strengthen the base and, as the right side has been fully cleaned out, it seemed unnecessary to remove the whole of the support of the left side.

This base of the skull is of the greatest interest. The frontal lobes of the brain rest on the roofs of the orbits, and there is a large surface formed by the orbitosphenoids. The sutures between the orbitosphenoids and the frontals cannot be made out

with certainty, but manifestly the structure of the orbitosphenoids is much more human than anthropoid. In fact, if three figures were drawn of this region in the Chimpanzee, Plesianthropus and man, anyone would say that Plesianthropus bears very little resemblance to the Chimpanzee and is strikingly like man.

The cribriform plate is less deeply placed than in the Chimpanzee, and it has a median small crista-galli, but much less developed than in man. We indicate what may be the limits of the plate in front and behind. There is a well marked furrow between the two optic foramina, and the anterior clinoid processes, which are nearly on the same level as the upper part of the orbitosphenoids, are deeply notched, apparently by the carotid arteries.

Laterally the orbitosphenoids, on passing outwards, make, with the back of the frontals, well developed plates which divide the temporal fossae from the frontal. This is a character of great importance. This arc of bone seems to be an invariable human character, and it is certainly generally, possibly always, absent in anthropoids. Weidenreich, in the recently published "Robert Broom Commemorative Volume" (1948), has called attention to it in connection with the status of Australopithecus.

He says (p. 157):— "Frontal and temporal lobes are sharply separated from each other in the human endocasts and brain itself, while they hold together in anthropoids. Australopithecus reveals a simian pattern." He figures Schepers' restoration of the Australopithecus brain, but he evidently considers it in error. We have examined anew the type Australopithecus skull and can say that in this sylvian fissure there is clear evidence of a bony plate similar to that in Plesianthropus. Of course in a cast, bone and matrix cannot be distinguished unless very carefully differentially coloured. But clearly in this character Australopithecus, like Plesianthropus, is human, and not simian.

This dividing ridge of bone can be seen not only in this No. 5 skull but in skulls Nos. 7 and 8. In the Orang there is a slight division of the temporal from the frontal lobe formed by the frontal bone, but in the Gibbon there is no trace of it. In the Baboon there is a slight indication of a division formed by a little ridge on the alisphenoid, but the frontal usually takes no part in it nor does the orbitosphenoid. In Cercopithecus there is a little dividing ridge formed by the frontal, and in Macacus there is a little ridge formed by the alisphenoid. In Colobus, however, we have a skull with a condition that approaches the human. The orbitosphenoid has a distinct ridge that passes outwards to join a well marked ridge formed by the frontal just above the suture with the front of the alisphenoid. It is interesting to find this human character in a pre-anthropoid, which is lost in the anthropoids; and one wonders whether it is a parallel development or an early character retained by man.

The left side of the back part of the base has been largely left protected by the lime deposit, as the bone is in a somewhat rotten condition. On the right side it has been cleaned out but, as the sutures are not satisfactorily shown except that between the temporal and occipital bones, there is little to be seen that is not better shown in Skull No. 8.

The median section of the skull is of considerable interest and the following points may be noted. Though in the figure (fig. 6) we give, no frontal sinus is shown, this is because we do not know whether a median section cuts a median part of the sinus. In the figure we give of the skull with the top removed, two lateral frontal sinuses are shown.

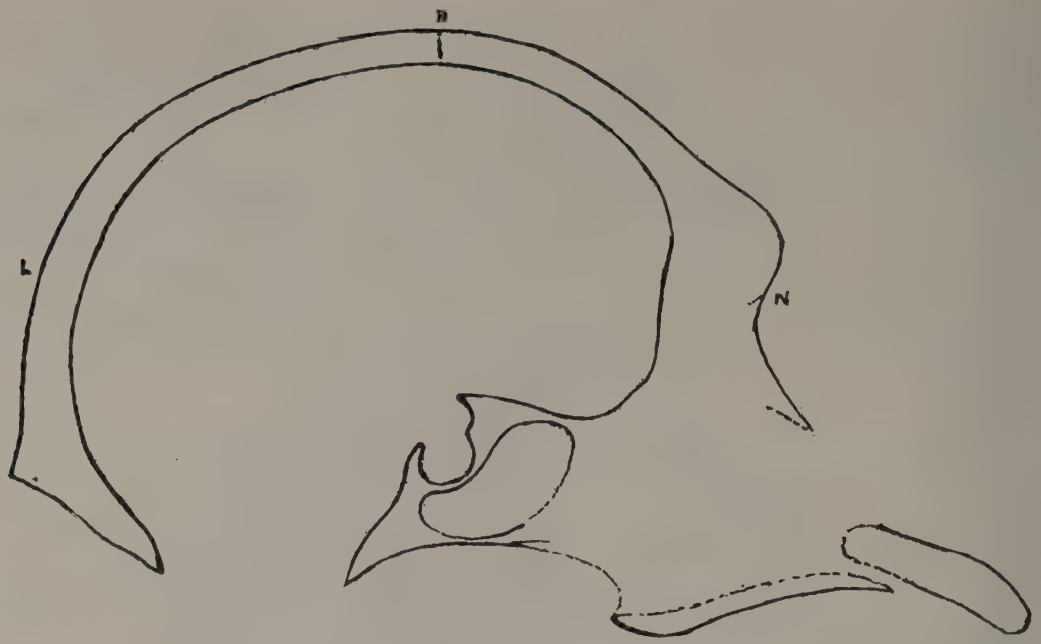

FIG. 6.— Median section of *Plesianthropus transvaalensis* (Broom). Skull No. 5. Two-thirds natural size. N. is the Nasion; B. approximate position of Bregma; L. approximate position of Lambda.

Presumably they join a central part, but this could only be determined by cutting through the unbroken supraorbital ridge.

Behind the nasal region the frontal looks comparatively thick. This is because we have drawn the section through the median frontal crest. The frontal lobes extend appreciably farther forward than the line of the crest in the drawing.

In the base of the skull the hypophyseal fossa is seen to be remarkedly well developed. This is a human character. In the anthropoids the fossa is usually much less developed. In the Gibbon the fossa is quite shallow, and in some Chimpanzees it is also shallow. In the old world monkeys on the other hand it is usually well developed. In Colobus, Cercopithecus, Mormon, Papio and Macacus it is deep.

Below the fossa there is seen a very large median sinus. This is a character in which Plesianthropus agrees with the Chimpanzee, Gorilla and man; though there is considerable variation in the sinus. In the Gibbon there is a large sphenoidal sinus, but in the old world monkeys it is usually absent, though quite a well developed one is present at least in some specimens of Cercopithecus.

Skull No. 6 is a very imperfect female skull. We have most of the left side of the face with the anterior half of the palate well preserved. We also have a considerable part of the brain case in very bad condition, and without any contact with the front part of the skull.

In size and most characters this specimen agrees closely with Skull No. 5, but as it is considerably crushed and very imperfect it seems hardly worth any detailed description. We give a photograph of the palate and one of the face. The sockets are preserved of the incisors, canines and 1st right premolar, and the crowns of the two left premolars, much of the 1st left molar, the 2nd right premolar and the 1st and 2nd molars and half of the 3rd. The palate, so far as preserved, is very similar to that of Skull 5. The

molar teeth are considerably worn, and the right 2nd molar has a well marked Carabelli pit, and probably had a Carabelli cusp. The 3rd molar also has a broad Carabelli pit, and almost a cingulum inside a large lateral pit between the two inner cusps.

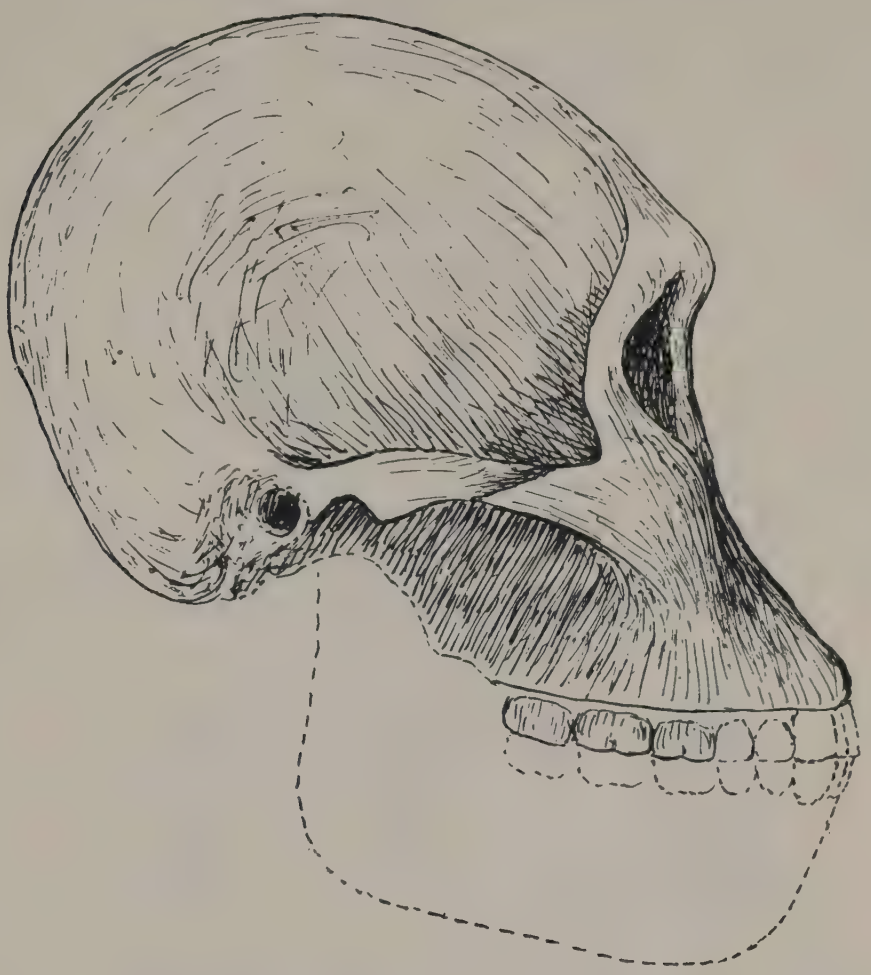

FIG. 7.— Side view of *Plesianthropus transvaalensis* (Broom). Skull. No. 7. Two-thirds natural size. Drawn as preserved. The lower part of the parietal and upper part of the temporal are considerably crushed. The face is uncrushed, but probably the lower part of the occiput is crushed forwards.

Skull No. 7 is much better preserved (fig. 7). We have rather more than half of the face, and almost the whole of the right side of the brain case. The palate and teeth are considerably crushed and broken. The right side of the skull, in the region of the lower part of the parietal and the upper part of the temporal, is a little crushed in, and the whole occipital region appears to have been pressed forward, but it is difficult to say how much; and though the occipital and upper parietal regions are rounded without very manifest breaking we think it likely that the skull was considerably longer — perhaps even as much as 20 mm. We have drawn the skull and the median section as they are preserved. If we could believe that the skull had been artificially deformed during growth the appearance could be accounted for. In some deformed Amerindian skulls we find a condition remarkably like that in this Sterkfontein skull. Most likely the condition is due to slow postmortem crushing without very manifest breaking of the bones.

While Skull No. 6 agrees closely with No. 5, this No. 7 differs very considerably. The side view shows that the skull as preserved is relatively short, and the occipital region instead of having an angled torus is rounded, and the slight indication of the crest more like that in most human skulls. The mastoid region is very low down, and the whole back part of the skull rounded in almost human fashion.

The ear and glenoid regions, though damaged, seem to agree with those in Skull No. 8.

Much of the middle of the top of the skull is preserved, and it shows that the skull at the top has a distinct rounded median ridge, and the impression of the temporal muscle comes up nearly to the middle line. Altogether the skull almost looks as if it had been artificially deformed, but this may be due to crushing.

The median section is seen to differ very considerably from that of Skull No. 5. There is a very large median frontal sinus.

The measurement from the glabella to the back of the occiput is about 129 mm.; and the greatest width is very roughly about 114 mm. This latter measurement is, however, only very approximate as the temporal region of the skull is considerably crushed, and we have not got the exact middle line in the middle parietal region. We think, however, that the breadth cannot be less than 114 mm., and maybe over 120 mm. If it is 114 mm. the cranial index would be about 88.4, or extremely brachycephalic.

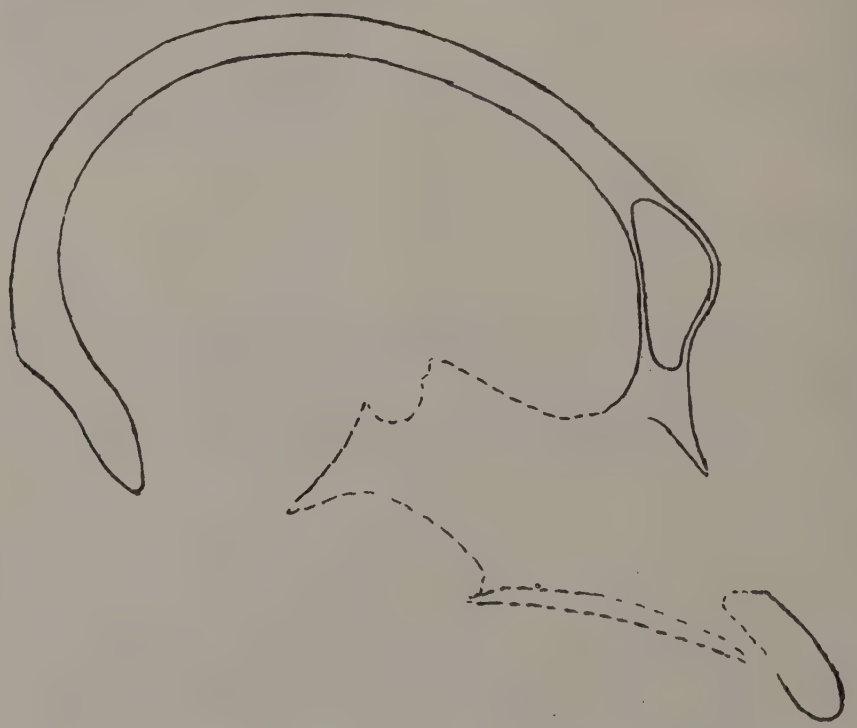

FIG. 8.— Median section of skull of *Plesianthropus transvaalensis* (Broom). Skull No. 7. Two-thirds natural size. Drawn as preserved. Probably the occiput is crushed forwards considerably.

We give a side view of the skull, and a photograph of the face. The side view, when the mandible is restored, shows a skull that appears to be considerably more man-like than ape-like.

Skull No. 8 was found in an old dump, which was probably the remains of quarrying operations of 30 or 40 years ago (fig. 9 — 10). Though the dump was very carefully gone over only part of the top of the skull, and a considerable part of the base were found. Probably the other parts were burnt in the lime kiln. Still, what we have is of the greatest importance.

The top of the skull consists of part of the frontal, about the upper halves of the two parietals, and about the upper fourth of the occipital. The sutures are well seen.

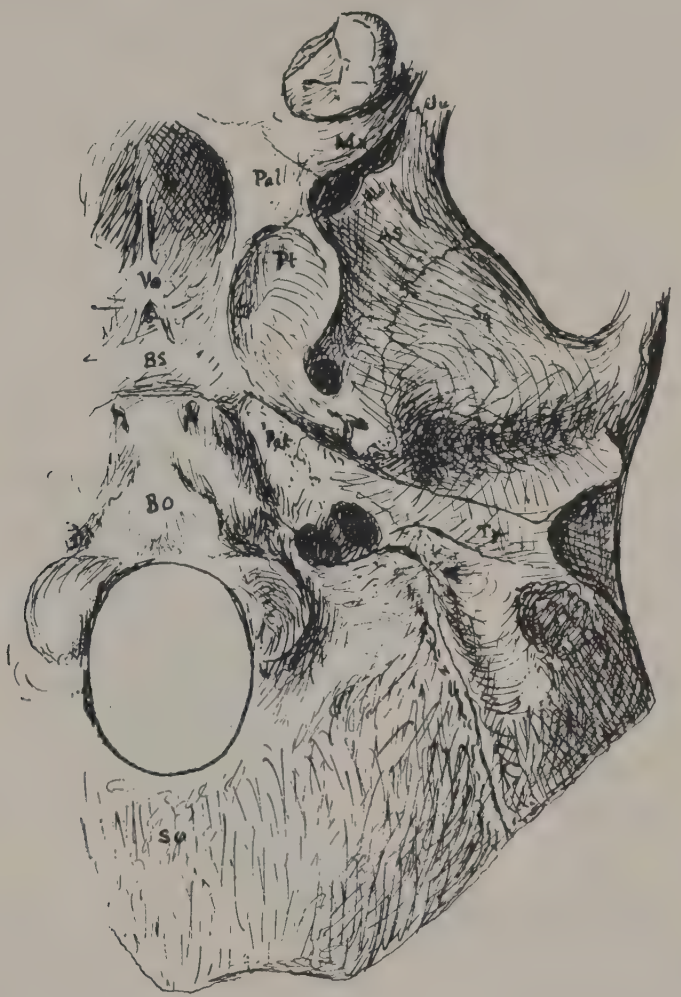

FIG. 9.— Base of imperfect skull of *Plesianthropus transvaalensis* (Broom). Skull No. 8. Natural size. A.S. Alisphenoid; B.o. Basioccipital; B.s. Basisphenoid; Ju. Jugal; Mx. Maxilla; Pal. Palatine; Pet. Petrosal; Pt. Pterygoid; S.o. Supraoccipital; Sq. Squamosal; Ty. Tympanic; Vo. Vomer.

The basal portion gives us the lower two thirds of the occiput, much of both temporals, the left showing perfectly all the structure of the glenoid region, much of the sphenoid and the back part of the left maxilla with a 3rd molar tooth somewhat worn.

We thus have every detail of the structure of the skull around the base of the occiput, and of the left pterygoid and basisphenoid regions. The left greater wing of the sphenoid is preserved and we see its relations to the back of the maxilla and to the front of the temporal.

Inside the skull we have practically every detail of the structure of the posterior fossa, of the walls of the foramen magnum, and of the posterior side of the petrous portion of the temporal. We also have almost the full structure of the middle fossa. We have much of the left temporal arch preserved and the inner side of the outer wall of the left orbit. Sphenoidal and ethmoidal sinuses and much of the left maxillary antrum are seen. The bone is sufficiently well preserved to admit of its being satisfactorily cleaned; and we may thus say that we know the back of the base of the skull of Plesianthropus as satisfactorily as we do that of the human skull. From the size of the brain and the size of the 3rd molar, we can say that the skull is most probably that of a female.

The foramen magnum measures in greatest length 25 mm., and its greatest width is 21.3 mm. The foramen is a rather broad oval and the front border is as bluntly curved as the posterior. The condyles are relatively small and about twice as long as broad. Their shape and relations to the neighbouring structures are shown in the figures and photographs given. A considerable part of the back of the median plate can be traced.

The portion of the occiput behind and to the sides of the foramen magnum is remarkably like that of man, and though the foramen and the condyles are smaller than in man the lower part of the occiput is as wide as in some Bushmen skulls. There is no postcondylar foramen, but there is a distinct concavity behind the outer side of each condyle.

At a distance of 25 mm. from the outer side of the foramen magnum we find the suture between the occiput and the back part of the temporal bone. The suture runs backwards and a little outwards from near the stylomastoid foramen in the middle of a well developed bony ridge. The part of the occiput behind the foramen magnum makes an angle with the main part of the base of the basioccipital of about 49°. The jugular process is well developed and essentially similar to that in man.

The basioccipital region is relatively short and has a pair of elevations presumably for the rectus capitus anticus muscles. There is a deep transverse groove in front, apparently in the region of the basioccipital — basisphenoid suture; and this is practically in the same plane as the front of the petrosal bone.

The left temporal bone is almost perfect, and in most of its structure it is surprisingly similar to that of man. We think that if this temporal bone had been found by itself in Borneo or Java it would have been referred by most anatomists to a primitive type of man.

In the posterior part of the bone there has been a fairly well developed mastoid process, but much of it has been gnawed off before fossilisation. Still, from the base remaining we can see it has been pointed and rounded. Inside of the mastoid is a deep and wide digastric fossa, which is continued back to the sloping and smooth back part of the mastoid region.

The external auditory meatus is relatively large, and the outer part is a well marked funnel-shaped depression. Posteriorly the depression is bounded by a well marked ridge which is really the front of the mastoid region, and anteriorly by the postglenoid process. Above, and a little behind the auditory funnel is a very distinct spina supra-meatum. This spine is so generally present in man that it might be regarded as a human character, and is used by aural surgeons as one of their guides. How frequently it occurs

in the Gorilla, Chimpanzee and Orang we cannot say. It is certainly occasionally present in the Chimpanzee and Orang. We have not seen it in the Baboon or Cercopithecus, but we find an indication of it in a specimen of Colobus.

The outer edge of the postglenoid process is in the same tangential plane as the meatal spine, and the outer edge of the tympanic is about 10 mm. further in. This outer end of the tympanic curves round inside the postglenoid process, and the greater part of the anterior side of the tympanic forms a continuous wall to the back of the glenoid fossa. This is the typical human condition which never, so far as we are aware, occurs in any anthropoid or cercopithecid. Occasionally in the Chimpanzee the auditory meatus is relatively low, and the inner part of the tympanic is continuous with the back part

FIG. 10.—Inner side of base of skull of *Plesianthropus transvaalensis* (Broom). Skull No. 8. Natural size. A.S. Alisphenoid; Fr. Frontal; Pa. Parietal; Pet. Petrosal; Sq. Squamosal.

of the squamosal glenoid surface, but never, apparently, with practically the whole of the front of the tympanic. The nearest approach to the typical human condition that we have seen is in a not quite fully grown Orang, but even here only a small part of the tympanic forms the glenoid wall.

Curiously enough Colobus, which shows so many human characters, has occasionally an arrangement of the tympanic and postglenoid process that is much more human than what we find in the anthropoids.

The back part of the tympanic forms a marked ridge which runs inwards and slightly forwards to the outer side of the jugular depression. At its inner third there is

a very prominent ridge, but there is no trace of a styloid process. As a styloid process is so commonly present in man, we may regard its absence as a prehuman character. Behind the posterior tympanic ridge is the small foramen for the VIIth nerve.

At the inner end of the posterior tympanic ridge is a rounded depression, which is divided by a bony plate into the carotid foramen in front and the jugular foramen behind, and to the inner side. Though the condition in man varies considerably, the majority of human skulls we have examined have the carotid and jugular foramina in a common depression. On the other hand, in the Chimpanzee skulls we have examined, the carotid foramen is in front of the jugular depression. And this is the condition in Baboons and Cercopithecus. In a specimen of Colobus on the other hand the carotid foramen is practically in the jugular fossa. Though the point is probably of comparatively little value, the structure of the jugular fossa in this Plesianthropus skull approaches more to that of typical man than to that of the Chimpanzee. In a young Orang skull, on the other hand, we have a condition not very unlike that of this Plesianthropus.

The anterior and inner part of the petrous bone is essentially as in man. There is a bony process apparently for the levator palati. The condition is almost exactly as seen in an Australian skull we have. But the condition is also not unlike that seen in some Chimpanzees.

The glenoid cavity is perfectly preserved. It is a deep transverse hollow formed on the back of the squamosal. Behind we have a wall formed about half by the squamosal and half by the tympanic. In front the cavity is bounded by a rounded ridge, the *eminentia articularis,* which runs from the tuberculum articulare inwards towards the foramen ovale. In the neighbourhood of the inner end of the glenoid cavity, the squamosal passes almost vertically downwards to form an inner wall. It will be seen from figure 9 that the whole glenoid region is essentially similar to that of man. The cavity differs in Plesianthropus in being appreciably larger and a little more definitely transverse. The whole cavity differs very considerably from those of any anthropoids we have been able to study.

Much of the base and practically the whole of the great wing of the sphenoid are preserved, and the left pterygoid. Here again the agreement with the human structure is much closer than with the condition in any anthropoid or cercopithecid.

The basilar process, or what we might preferably call the basioccipital, meets the basisphenoid and, though there is probably no suture between the two bones, there is a very marked transverse groove which probably agrees with the suture. On this lower part of the basisphenoid we have the back of the vomer. It is difficult to be sure whether two little lateral plates are parts of the vomer or the surface of the basisphenoid, and it does not seem justifiable to chip them off to make sure. Most probably the back part of the vomer is as we figure it. It is not unlike the condition in both man and the Chimpanzee.

At 10 mm. outside the middle line there is a curved bony ridge which bounds the posterior nares and passes downwards to the back of the palate. Immediately outside this ridge is the rather well developed pterygoid fossa. No suture can be seen dividing the pterygoid from the basisphenoid, nor can a suture between the external pterygoid plate and the sphenoid be seen on the outer side. Though the region of the Hamular process

is not quite perfect, the arrangement of the bones appears to be almost exactly as in man. In the above part of the pterygoid fossa the palatine forms a considerable part of the fossa, and on the outer side a narrow strip of the palatine is seen wedged between the pterygoid and the maxilla. In the Chimpanzee the palatine forms only a very small part of the fossa, though a considerable part is usually seen between the pterygoid and the maxilla. The condition of the parts in this Plesianthropus is thus distinctly more human than Chimpanzee-like. In the Baboon and smaller cercopithecids the palatine always seems to appear as a small part of the fossa. Occasionally in the Baboon the palatine forms quite a large part.

Outside the pterygoid region is seen the large lateral part of the sphenoid — the alisphenoid of the typical mammals. The foramen ovale is large and oval, and is situated outside and behind the pterygoid base. This is exactly the situation in man, but in the chimpanzee it is usually situated a little more anterior. Outside the foramen there is a distinct strip of bone 6.5 mm. wide between it and the squamosal. This is a typical human character apparently present in all normal human skulls. In the Chimpanzee the suture runs back close to the foramen.

Passing backwards and outwards from the foramen ovale is a well developed little process of bone, which has a close articulation with the inner lower and posterior corner of the squamosal. The structure is as shown in the figure, but without damaging the bones it seems impossible to determine with certainty whether there is a foramen spinosum.

The alisphenoid-squamosal suture passes forward as a gentle curve for about 20 mm. and there passes outwards, forwards and upwards as shown in the figure. The great wing of the sphenoid is almost exactly like that of man. There is a well marked ridge across the wing as shown in the figure dividing it into an inner and an outer part. The inner part is markedly concave and passes downwards to form the lower part of the outer pterygoid plate. At the anterior end of the transverse ridge is a prominent pointed process, such as is seen in most human, Chimpanzee and Orang skulls. The anterior end of the upper part of the wing articulates with the jugal apparently as in man, and it also meets the maxilla at the front of the spheno-maxillary fissure. We have not sufficient of the upper end of the wing to say whether on the outer side it meets the parietal; but from the width of the upper end of the wing, and from the fact that in the inner side of the alisphenoid clearly articulates with the parietal, which lies across the top of it, we may assume as almost certain that on the outer side the top of the sphenoid wing articulates with the frontal and the parietal, as in most human skulls. Clearly the upper part of the wing is larger than in the Chimpanzee, and appears in its relations to be more human. We do not, however, consider that the exact relations of the bones in the pterion region is of such importance as some attach to it. But on the evidence we have, the affinities of this Plesianthropus skull are definitely more human than Chimpanzee-like.

The upper side of the base gives us most of the details of the occipital and left temporal fossae, and much of the inner side of the outer wall of the left orbit.

Except in being smaller, the whole occipital fossa is almost human. For each lateral hemisphere of the cerebellum there is a deep rounded depression. This is, in our opinion, more like that of man than that of any of the anthropoids. Round the foramen

magnum there is a well marked thickening of the bone, especially on the two sides of the posterior half. The sides wall above the condyle has the foramen for the hypoglossal nerve. This is single as in man. In the Chimpanzee it is frequently double.

The groove for the lateral sinus is very well marked. It can be traced round from the jugular fossa, over the back part of the temporal bone and round above the cerebellar fossa to the median torcular protuberance. In man the sinus sometimes runs over the lower part of the parietal. In the Chimpanzee the sinus is generally below the parietal. In this fossil skull the sinus is almost certainly only on the occipital and temporal bones.

The posterior side of the petrosal resembles that of man very closely. There is a large foramen for the VIIth and VIIIth nerves situated as in typical human skulls, and towards the outer end of the petrosal and near to the sinus a very well marked *aqueductus vestibuli*. In the Chimpanzee skulls we have examined, this aqueduct is smaller and closer to the foramen for the VIIth and VIIIth nerves.

The anterior side of the petrosal is also essentially similar to that of man, but is also not unlike that of the Chimpanzee. The inner point of the petrosal is in contact with the side of the basisphenoid, and the carotid canal lies immediately in front of the point of contact of these two bones.

The arrangement of the bones, in the neighbourhood of the carotid canal and the foramen ovale, differs considerably in human skulls. In many human skulls, and in some Chimpanzee skulls, the carotid canal has its outer side formed by a small process which passes backwards from the alisphenoid to approach or meet the petrosal. In other human skulls there is no outer wall to the canal where it enters the brain cavity. This is the condition in this fossil skull. The carotid canal opens externally as shown in figure 10. It would not be safe to excavate the delicate bones further than we have done. Outside the carotid is a deep furrow, probably a complete passage down to the foramen lacerum, and this furrow is continued outwards to the small hiatus Fallopii.

The foramen ovale has a thick wall of bone both behind and outside. The suture between the alisphenoid and the squamosal is about 7 mm. outside the foramen, and it is impossible to be sure whether there is a foramen spinosum. In this region a meningeal artery appears to enter the brain cavity, and pass outwards along or near the suture between the petrosal and the squamosal, but whether it comes through the foramen spinosum could not be determined without damaging the structures. The course of this arterial groove is shown in the figure. It can be closely matched in a Chimpanzee skull we have.

FIG. 11.— Median section of base of skull (No. 8) of *Plesianthropus transvaalensis* (Broom). Natural size. B.O. Basioccipital; B.S. Basisphenoid; Pal. Palatine; S.O. Supraoccipital. Vo. Vomer.

Along or near the suture between alisphenoid and the squamosal an anterior arterial branch passes. The arrangement of these arteries is definitely more like those of the Chimpanzee than man. On the other hand the sphenoidal great wing extends outwards and upwards as in man, and is not like that of the Chimpanzee where it is relatively short.

In front of the foramen ovale is the foramen rotundum, and immediately above it is the base of the posterior end of the spheno-maxillary fissure. At the upper end of the alisphenoid is preserved a little bit of the parietal, showing that on the inner cranial wall the parietal lies above the alisphenoid. This is more a human than anthropoid character. A similar character is found in the skull of a Colobus.

There is a very large sinus occupying the greater part of the basisphenoid and apparently invading the back of the basioccipital. This large sinus is connected with a sinus on either side lying at the bases of the pterygoids. A similar condition is found in many, perhaps most, Chimpanzee and human skulls.

One other point of interest is seen in this imperfect skull. We have a fairly satisfactory view of the inner side of the outer wall of the left orbit. The structure is dealt with in a later part of the paper.

MANDIBLE OF PLESIANTHROPUS.

ON 24TH JUNE, 1947, we discovered the nearly complete mandible (fig. 12), and with it much of a humerus and part of a scapula, at a spot about 12 feet South of that where Skull No. 5 was found, and at a level about 2 feet higher.

The mandible though crushed is nearly complete and most of the teeth are preserved. The left side of the jaw is nearly perfect, lacking only much of the back margin of the ascending ramus, and the condyle has been detached. Unfortunately the posterior third of the jaw is in the counterslab, and could only be removed and joined to the anterior part at much risk of it being badly damaged. As it is, we have the inner side of the ascending ramus exposed.

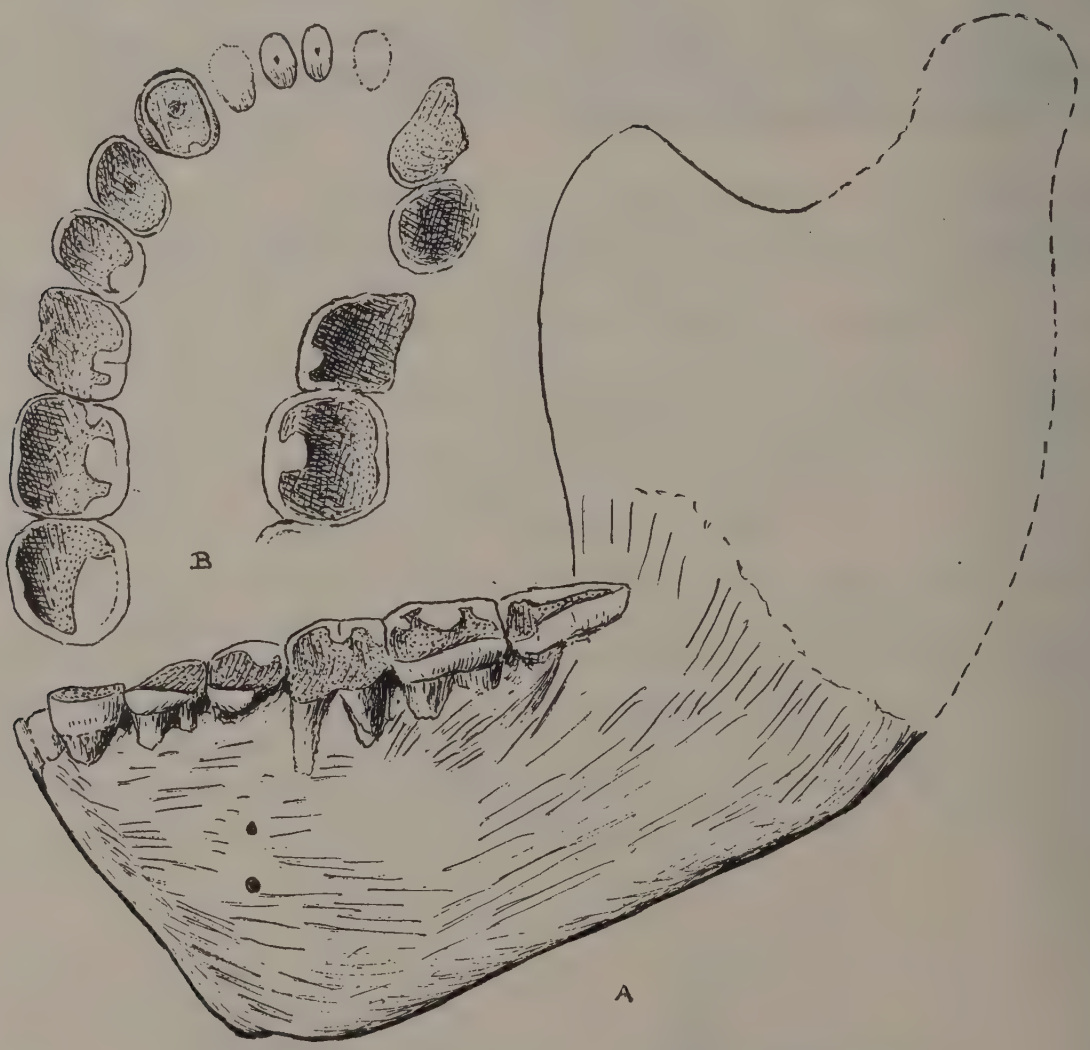

FIG. 12.— A. Left side of mandible of large male *Plesianthropus transvaalensis* (Broom). Most of the ascending ramus is preserved on the counter slab, but it has not been considered safe to remove it. B. Occlusal view of the teeth. The right half of the mandible is badly crushed in on the left. The right canine has probably dropped out — perhaps during life. The 3rd right molar is preserved but is overlain by the front of the right ascending ramus. Both figures natural size.

The right side of the jaw is badly crushed on to the left, but nearly complete, and it gives us nearly the whole of the ascending ramus, except for the condyle.

All the teeth of the left side are present, though the 2nd incisor has been damaged, and all are much worn. In the right side the incisors and premolars and molars are preserved, but the canine has probably been lost in early life, and the space where it should have been is largely closed by the approximation of the 2nd incisor to the 1st premolar.

The jaw is remarkably massive, and though the crushing and imperfections of the ascending rami leave a little uncertainty as to the posterior border and condyle, a pretty accurate restoration can be made. Fortunately the left horizontal ramus is almost perfect.

When the jaw is restored the length from the front of the 1st incisor to the middle of the back part of the ascending ramus is about 130 mm. From the lower part of the symphysis to the condyle is about 150 mm.

The symphysis is quite well preserved, but as the right ramus is crushed into the left it is impossible to clean out the whole of the back without removing the crushed right side, which certainly would not be justifiable. We have, however, the front and the lower border of the symphysis nearly perfectly preserved, and of the inner or posterior side we have about the lower half satisfactorily exposed, and we can make an approximate drawing of the upper half. There is only a little part in the middle where there is no evidence.

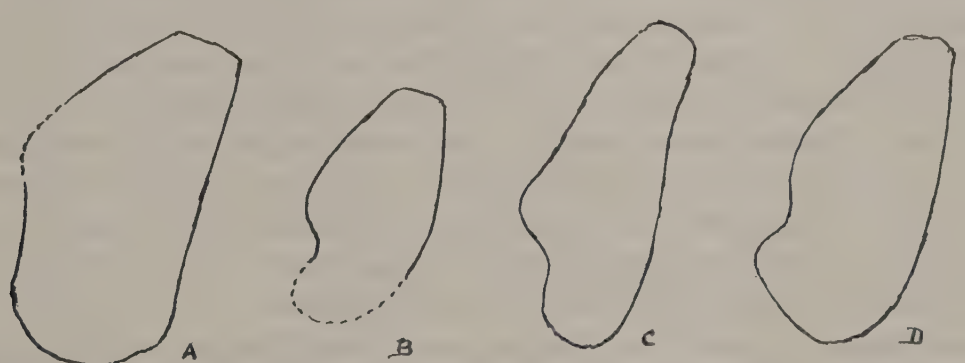

FIG. 13.— Sections across the symphysis of the mandible. A. Large male *Plesianthropus transvaalensis* (Broom). B. Young male *Plesianthropus transvaalensis* (Broom). About 8 or 9 years. C. Adult *Proconsul africanus* Hopwood. From cast. D. *Palaeanthropus heidelbergensis* Schoet. From cast. All figures natural size.

The first striking point is that the front of the symphysis is nearly straight from the alveolar border to the lower part of the chin. The whole of the front of the symphyseal region is not very unlike that of the Heidelberg jaw, but it is a little straighter, and at the lower part in this Plesianthropus jaw there is a little elevation or knob suggestive of an incipient chin. The lower part of the symphysis is rounded and also not unlike that in the Heidelberg jaw. There is not even a trace of a simian shelf. When we look at the back of the symphysis we find no specialised pit. There is even less indication of a pit than there is in the Heidelberg jaw. In Proconsul there is no trace of a simian shelf, but there is a depression corresponding to the very marked pit of the Chimpanzee.

Clearly, there is scarcely any resemblance between this Plesianthropus symphysis and that of any of the living anthropoids; and to find any symphysis at all like it we have

to examine those of various early types of man and living human races and the symphysis of the early anthropoid Proconsul.

The horizontal ramus of the jaw is very massive. In the region of the 1st molar it has a thickness of 24 mm. The corresponding measurement in the Paranthropus jaw is 23 mm. In the Mauer jaw it is 19 mm. and in the Chimpanzee about 14 mm. The depth of the jaw at the 1st molar is 37 mm. The corresponding depth in Paranthropus is 35 mm.

The ascending ramus is extremely well developed. The tip of the coronoid process is 86.5 mm. above the line along the base of the horizontal ramus. In the Mauer jaw the corresponding measurement is about 70 mm. The Mauer jaw has long been regarded as remarkable for the great antero-posterior measurement of the ascending ramus. Its narrowest measurement made on the cast is about 53 mm., but in the Plesianthropus jaw the corresponding measurement is about 60 mm. It is impossible to give it accurately as the back of the ascending ramus on the left side is missing, and on the right side it is somewhat crushed. The measurement cannot be less than 60 mm. It may be 65 mm.

The ascending ramus is at present on the counterslab, and shows the inner side of the upper part of the coronoid process. The process is broad, with a strong flattened ridge of bone running up to the front of its upper end. If the Mauer jaw had a pointed coronoid process the general resemblance would be considerable. The resemblance of this upper part of the jaw to that of the male Gorilla and male Orang is not very close. It bears considerable resemblance to that of the male Chimpanzee, but of course it is very much larger. There is no close resemblance to the condition in Proconsul. In man there is a great variety in the structure of the coronoid process. In most modern types the coronoid is rather feebly developed, and though the typical human coronoid is only about half the size of that in Plesianthropus there is a fair general agreement in most human jaws. It is when we compare the jaw with those of early man that we find the closest affinity. In Sinanthropus the male jaw is not unlike that of Plesianthropus though the ascending ramus is much smaller in its antero-posterior measurement. Neanderthal man also has a jaw a little like our fossil form, but on the whole the human jaw that comes nearest to that of Plesianthropus is one of the Wadjak jaws. If this Wadjak jaw had larger molars, premolars and canines and the chin a little less developed it would be not unlike that of our South African Ape-man.

As we may get a better jaw any time, and less worn teeth, it seems unnecessary here to describe the jaw at greater length. The figures given will show the characters of both.

The most interesting characters, however, we must refer to. The incisors are relatively small, and if unworn would probably be not unlike those of man. They are very much smaller than those of the large living anthropoids. In even a small male Chimpanzee the measurement across the roots of the four lower incisors is 28 mm., but in this large male Plesianthropus jaw the four only measure 23 mm. The canine in this Plesianthropus at its base measures 10.4 mm. by 8.5 mm., but in this small male Chimpanzee the top of the lower canine root measures 10.2 mm. by 8.2 mm. But though the teeth are about equal in size, the Chimpanzee canine passes in front of the upper canine and has been scarcely at all ground by it, while in the Plesianthropus jaw the lower canine has been ground down quite flat by biting against the upper canine. The canines in the two beings must have functioned very differently.

We know that in female anthropoids, where the canines are smaller than in the males, they occasionally bite against each other. But do the male anthropoid canines ever bite against each other? We wonder if any of those who still hold that Plesianthropus is a variety of Chimpanzee or Gorilla have come across such a case. If it occurs it must be so rare that it can be regarded as an abnormality.

As will be seen in figure 12 the whole dentition has been ground down to practically one level as in the Heidelberg, Wadjak and Sinanthropus jaws, and we believe this condition never occurs in normal male anthropoids.

In dealing with the Plesianthropus dentition we show that the upper male canine is also ground down exactly as is the lower, though this specimen belongs to a different individual.

PERMANENT DENTITION.

WHEN THE BOOK ON "The South African Fossil Ape-Men" was published in 1946, descriptions were given of numerous upper premolars and molars, and a few upper incisors and canines, and of the lower teeth, badly worn premolars and molars, an unworn crown of a canine, and a worn adult canine, of a perfect 2nd premolar and of a perfect 3rd molar.

Our researches in 1947 have greatly added to our knowledge of the dentition. We now have about 135 teeth of Plesianthropus, and we may later publish a special monograph on the dentition somewhat similar to that of Weidenreich on the teeth of Sinanthropus. At present it seems unnecessary to do more than to give some account of those teeth which were previously unknown or imperfectly known.

In 1946, nothing was known of the upper milk dentition, and only a fragment of one tooth of the lower. Now we know fully the structure of the upper milk molars, and have a complete knowledge of all the lower milk dentition.

In our opinion the structure of the teeth gives a better clue to the affinity of a primate than either the brain, the bony skeleton, the muscular anatomy, or the structure and development of the placenta. Further we know practically nothing of the fossil apes, except their teeth.* It was the consideration of the brain structure and the teeth that led Dart to regard Australopithecus as probably allied to man; and it was the milk dentition that convinced Broom that Australopithecus was not at all closely allied to the living Anthropoid apes. Now that we have an almost complete knowledge of the dentition, both deciduous and permanent, the case for the Australopithecids being allied to man, and differing greatly from the anthropoids, seems much stronger.

So far we have not discovered any good permanent upper incisors, but we have a number more sockets in addition to those previously known. We have thus a good idea of their size, and they seem to agree rather closely with those of modern man.

The width across the four upper incisor sockets in the female Plesianthropus skull (No. 5) is about 28.5 mm. In Skull No. 6 in which the sockets are also well preserved the width of the four is also 28.5 mm. The measurement across the incisor crowns would probably have been slightly more.

The width across the canine sockets in Skull No. 5 is about 42.5 mm., and across the two canine sockets in Skull No. 6 about 45.7 mm. The measurement across the canine crowns in both skulls was probably about 5 or 6 mm. more. The measurements across the canine roots in the Rhodesian skull is about 52 mm., and in Bantu skulls usually between 42 and 45 mm. Plesianthropus females seem to have had upper incisors and canines of about the same size as in modern man.

In Skull 5, the socket of the 1st incisor measures about 7 mm. by 7 mm. In Skull No. 6 it measures 8 mm. by 8 mm. The second incisor socket in Skull No. 5 measures 7.8 mm. by 5.2 mm.; in Skull No. 6 it measures 7.2 mm. by 6 mm.

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* The greater part of a skull of Proconsul — probably a female — has just recently been discovered by Leakey and his wife at Rusinga Island; and a fine mandible was discovered a couple of years ago. (Nov. 1948).

In Skulls Nos. 5 and 6 we have the canine sockets fairly well preserved. In Skull No. 5 the socket measures about 9 mm. by 7.6 mm.; in Skull No. 6 the measurement is 9.5 mm. by 7.5 mm. As an upper canine which we regard as a male has a measurement, at the point where the root joins the enamel, of 12 mm. by 8.5 mm. and the socket must have been appreciably larger, we are probably safe in assuming that Skulls No. 5 and No. 6 are those of females.

The type skull of Plesianthropus (Skull No. 1) has a canine socket which measures on the right side about 10.5 mm. by about 8.2 mm., and on the left side 10.2 mm. by about 7.3 mm., so we may assume as probable that this first known skull is also that of a female. Broom had thought it not improbable that the type skull is that of a male, but the discovery of this excellent upper canine seems to show that the type skull is that of a female.

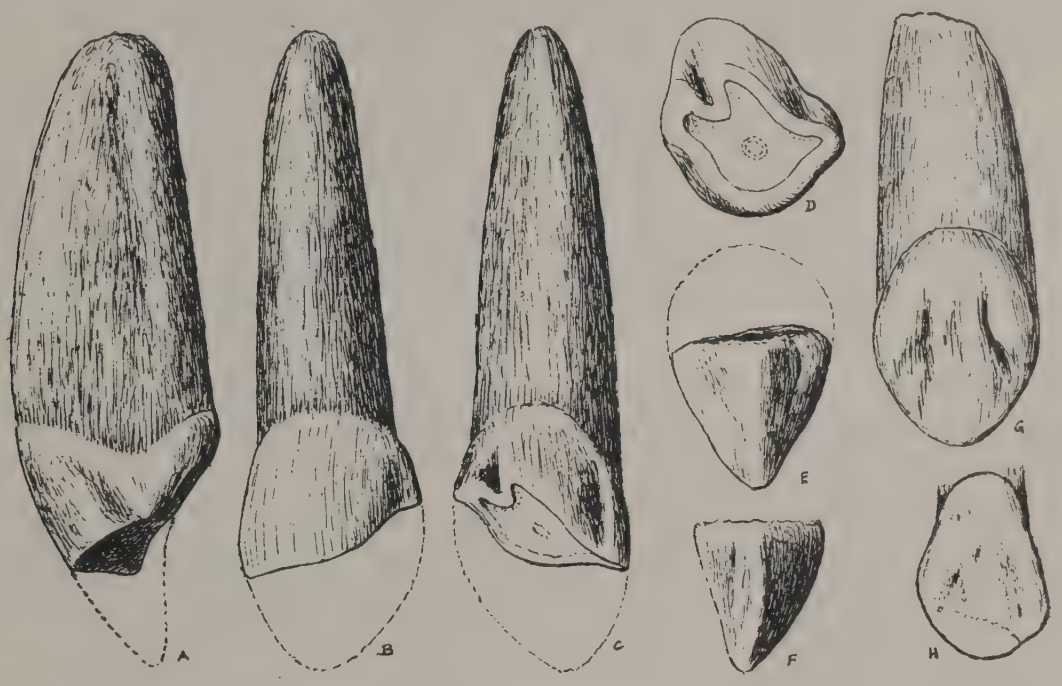

FIG. 14.— Upper canines of *Plesianthropus transvaalensis* (Broom) and other Primates. A. Left upper canine of male Plesianthropus, posterior view; B. Buccal view of same; C. Lingual view of same; D. Occlusal view of same. E. Lingual view of germ of left upper canine of Plesianthropus — probably female. F. Anterior view of same. G. Lingual view of left upper canine of *Sinanthropus pekinensis* Black — probably male (right reversed), after Weidenreich; H. Lingual view of left canine of Bantu. All figures twice natural size.

Skull No. 7 has the canine socket measuring 9.7 mm. by about 7 mm. There thus seems to be little doubt that the skulls No. 1, No. 5, No. 6 and No. 7 are all female skulls. In No. 8 we have no front teeth, but the brain is not much larger than in these others, and it is thus probably also a female skull. We have thus at present no good male skull.

As the male mandible is very much larger than must have been the jaws of any of these five skulls, we are probably right in considering that the male skull was much larger than the female.

The upper canine was previously known only by a very badly worn tooth apparently a female, and a well preserved slightly worn tooth also of a female. Now we have a perfect somewhat worn male canine, and about half the crown of a developing tooth probably a female.

The male canine was an isolated tooth. The root is perfect, but the crown is worn about half way down to an almost flat surface. When this surface is examined it is seen to be about one and a half times as long as broad and to have a very marked in-folding of the enamel on its posterior and inner part. From the lingual view of the tooth this infolding is seen to be part of an infolding that must have run up much of the posterior half of the inner surface. Two views given show the nature of this infolding (fig. 14). In the anterior half of the inner surface there is another depression, but this is merely a hollow and it does not affect the enamel except near the base of the crown.

The outer or buccal part of the crown is markedly convex transversely, and slightly convex from the base towards the point. Near both the anterior and the posterior sides there are slight depressions which have probably run towards the point of the tooth.

The anterior side of the tooth shows a marked groove running from near the base of the enamel to near the point of the root. On the posterior side there is a very slight similar groove. On the anterior side the base of the enamel pases down on the lingual and buccal sides of the root making almost a right angle, with the root showing well up between them at the base of what looks like an anterior cusp. On the posterior side the root goes up to the base of the rudimentary posterior cusp-like expansion, but it does not pass as far up as in front.

Though about half the crown is lost it seems probable that the crown was pointed as shown in the figures, and the part of the crown behind the deep infolding of the enamel may have formed a sort of posterior cusp.

The following are the principal measurements of the tooth: — Greatest width of the crown 12.2 mm., and greatest antero-posterior length as preserved 10.9 mm., but before wearing it was probably 11.3 mm. From the tip of the root to the top of the crown as worn the measurement is 33.1 mm. But when the tooth was unworn the total length would probably be about 38.6 mm.

The other important upper canine crown was removed from the imperfect snout that shows the upper milk molars. Though the canine crown is only about half developed it reveals to us the shape at least of the point of the tooth. As it is appreciably smaller than the male crown we may be justified in assuming that it is a female canine.

Only about half of the crown has been formed. When viewed from the front the portion developed has practically an equilateral triangular convex face without any marked grooves. When viewed from inside the lingual face is seen to have two grooves running down it as shown in the figure, but there is no infolding of the enamel as seen in the male tooth. Though the base of the crown has not developed we can be moderately sure that there could not have been any deep enamel infold even if the crown had fully developed. This crown shows both anteriorly and posteriorly fairly sharp slightly curved edges.

We know of no Anthropoid or Old World Monkey that has an upper canine at all closely resembling the canine of this male Plesianthropus. Of course if we compare it with

some canines of female Chimpanzees or Orangs we see a little resemblance in size, but we know of no case in any anthropoid where on the posterior part of the lingual surface the enamel is deeply infolded.

Weidenreich has figured an upper canine of a male Sinanthropus which certainly bears some resemblance to this Plesianthropus tooth. This is his "No. 16," which he figures in Plate IV, 38. Here we have on the lingual side two well developed grooves, the one on the anterior part being deep enough to be called an infolding of the enamel. We have given a reverse view of this tooth, which is a right canine, drawn from the cast, for comparison with the Plesianthropus tooth (fig. 14g). The interesting point is that the Sinanthropus tooth has two well marked furrows which we may regard as homologous with those in our tooth.

Weidenreich gives a figure of a Krapina canine which shows somewhat similar grooves; and slight indications of those grooves are common in modern man. We give a figure of the lingual face of a Bantu canine showing at least rudiments of the grooves (fig. 14h).

In the lower canines of Sinanthropus two well marked grooves seem to be the rule, and the posterior groove is usually a distinct infolding of the enamel which at times as in Weidenreich's "No. 73" seems to form at least a rudimentary posterior cusp. In the lower canine crown of Plesianthropus figured by Broom, Plate VII figures 51—54, we find a posterior infolding of the enamel very similar to that in the upper canine.

Von Koenigswald, in a paper just published in the "Robert Broom Commemorative Volume", discusses this lower canine of Plesianthropus. He thinks the crown has perhaps been "slightly damaged" and that it "would probably have extended further downwards than indicated in the drawings." In this he is in error. The crown is perfect, and is as shown in the figure published by Broom. Von Koenigswald compares the tooth with a fossil one from Yunnan, as had already been done by Broom. While there is some resemblance it is not very close. And while Von Koenigswald and Weidenreich both consider the canine to belong to a species of Orang (Pongo), we feel there are still doubts.

Von Koenigswald considers that "the evolutionary tendencies expressed in the lower canine of Plesianthropus are different from those of the hominids and that the canine of man never passed through the specialized stage which seems to be typical for the South African form."

The upper premolars and molars of Plesianthropus were well known in 1946, but we have many more specimens which it seems unnecessary to describe at present. It may, however, be pointed out that a Carabelli pit or depression is present in most of the upper molars, but we have only two specimens, showing what could be regarded as a Carabelli cusp.

In 1946, we knew only the perfect crowns of the lower canine, 2nd premolar and 3rd molar, and badly worn crowns of the two premolars and of the 1st and 2nd molars. Now, in the large male jaw which we discovered on 24th June, 1947, we have the full set of the lower teeth of the left side, and all those of the right side except the canine, which has apparently fallen out. We also have a few other well preserved molars, and we now have the perfect developing crowns of the 1st and 2nd incisors and of the 1st premolar.

The lower jaw which we found a few months ago shows the deciduous incisors, canines and molars and the 1st permanent molar; but though the teeth are perfect the jaw was so hopelessly decayed that the little of it that remained seemed not worth preserving, and as there were indications of the developing incisors and 1st premolar crowns, we considered it better to extract these even though it meant destroying part of the comparatively worthless jaw. We were rewarded by finding the perfect incisor and premolar crowns.

The first incisor differs little from that of modern man. Being completely unworn the top of the crown is seen to be crenulated, there being five cusplets of which the middle one is slightly the larger. The buccal surface is smooth and curved as shown in the side view. The lingual surface has a distinct median ridge running down from the middle cusplet. This surface is rather deeply concave.

FIG. 15.— Teeth of *Plesianthropus transvaalensis* (Broom). All twice natural size. A. Front view of left lower 1st milk incisor. B. Front view of left lower 2nd milk incisor. C. Outer view of left lower milk canine. D. Front view of crown of right lower permanent 1st incisor. E. Lingual view of crown of right lower permanent 1st incisor. F. Median view of crown of right lower permanent 1st incisor. G. Front view of crown of right lower permanent 2nd incisor. H. Lingual view of crown of right lower permanent 2nd incisor. I. Outer view of crown of right lower permanent 2nd incisor. J. Outer view of crown of 1st right permanent lower molar. K. Outer view of crown of 2nd right lower milk molar. L. Outer view of crown of 1st right lower milk molar. M. Outer view of crown of 1st right lower premolar. N. Posterior view of crown of 1st lower premolar. O. Occlusal view of crown of 1st right lower premolar.

There is little difference between this tooth and that of man, either in structure or in size. Weidenreich figures three 1st incisors of Sinanthropus. They are all a little worn; but they differ little from those of Plesianthropus except in being rather larger. Weidenreich also gives a figure of the unworn 1st incisor of an Orang. This also does not differ very greatly from the Plesianthropus tooth. It has five cusplets and a rather marked median ridge running down the inside of the tooth. The Orang crown is rather lower than the Plesianthropus tooth.

The following are the chief measurements of the tooth:— Height of the crown enamel on buccal side 11.8 mm., and on the lingual side 11.4 mm. The antero-posterior length of the top of the crown is 6.2 mm. The base of the crown measures 6.3 mm. by 4.5 mm.

The 2nd incisor crown is beautifully preserved on both sides. The left one is still in position in the specimen; but the right crown has been removed so that both sides can be studied. Like the 1st incisor the cutting edge is crenulated, but it differs in that the cusplets are not arranged in a straight line. There is a very well developed median cusplet which is broad and really represents two cusplets, the outer of which is much lower than the other and less distinct. The outer edge of the tooth is much shorter than the inner and is crowned by a well marked cusplet. The inner side of the tooth is almost as long as the median portion and has a well developed cusplet. Between this inner cusplet and the median one there is a very small rudimentary cusplet.

The front of the tooth is moderately smooth and rounded, but there is a distinct broad groove running from between the two main cusplets to about the middle of the tooth.

The side view of the tooth shows that the upper cutting two thirds of the tooth is relatively flat, and that this is supported by a wide antero-posterior base.

The inner side of the tooth is markedly concave, and there is a feeble hollow running down from between the two main cusps, and a rather marked hollow near the middle of the surface between the median line and the outer edge. The base of the crown is considerably thickened behind.

This tooth is not very unlike some 2nd lower incisors of Sinanthropus figured by Weidenreich, but it is manifest that in Pekin Man there is very considerable variation in the incisors. In size, our Plesianthropus incisors are distinctly larger and the crowns higher than in some, such as Sinanthropus 8, and Sinanthropus 10, and the upper cutting portion is much thinner in our teeth, and the back part of the base of the crown much more strongly developed.

In the Sinanthropus incisors figured by Weidenreich the crenulations differ markedly from those in the Plesianthropus teeth, but whether this is a matter of importance can only be known when we have more teeth of both the genera. In Sinanthropus there appear to be generally two broad lateral cusplets and two smaller median ones.

Weidenreich figures the young unworn incisors of an Orang. But these are very much larger than the Plesianthropus teeth. The 2nd incisor is interesting in showing that the outer side of the tooth is much shorter than the inner. The Orang tooth differs in having a strong median ridge on the lingual side.

On the whole, the Plesianthropus incisors seem to be rather nearer to those of modern man than are those of either Sinanthropus or the Orang, and they are very much smaller than are the incisors of the large living anthropoids.

The following are the principal measurements of the 2nd incisor:— Height of the enamel on the buccal surface 13 mm., height on the lingual surface 11.5 mm. Width of cutting surface (antero-posterior measurement) 7.3 mm.

We were fortunate in finding the perfect developing crowns of both the 1st lower permanent premolars. We give three figures of the crown of that of the right side (fig. 15). The 1st lower premolar is the most important tooth of the permanent dentition of a primate in affording a clue to the affinity. In man this is a bicuspid tooth. In all the anthropoids

it is a unicuspid tooth. In the Old World Monkeys it looks as if it had originally been a bicuspid tooth which had become highly specialized to form a cutting tooth with the upper canine.

When the crown of the Plesianthropus 1st lower premolar is viewed from above it is seen to be nearly rounded, and to have two low pointed main cusps. The height of the outer cusp is seen when the tooth is viewed from the buccal aspect. Here we see a well marked low median cusp and a very small cusp at each end of the outer side. From the top of the outer cusp a ridge of enamel runs forwards and backwards. The anterior ridge runs to the front of the crown, but the posterior runs round the back of the tooth to the inner side. A little in front of the middle plane of the tooth there is on the inner or lingual side an inner cusp which is almost as well developed as the outer and as high. Between the two cusps there is a blunt ridge interrupted in the middle. This transverse ridge divides the top of the crown into two subequal hollows or foveae. At the back of the inner cusp is a third small hollow. There is no distinct evidence of any cingulum anywhere round the tooth.

When we look for other premolars with which to compare the Plesianthropus tooth we naturally turn to Sinanthropus, and fortunately Weidenreich has been able to describe and figure quite a number of crowns of unworn 1st lower premolars. He says:— "there is a certain degree of variation in the development and distinctness of the described details but the general characters as a whole are always the same."

The Sinanthropus 1st lower premolar may be briefly described as having a rounded crown which near the middle of its buccal surface has a well developed blunt cusp. The lingual part of the crown is lower and from its middle part there is developed a blunt pyramidal cusp which is a little lower than the outer cusp. Between the two cusps there is a marked ridge of enamel which is cut across near its middle by a deep furrow.

In modern man the general features are similar, but the tooth is much smaller, and the wrinkles are usually smoothed out. The modern tooth might be said to be a degenerate descendant of the Sinanthropus tooth. Weidenreich figures a Krapina 1st premolar (after Gorjanovic-Kramberger). This tooth might be called an undegenerate human premolar, and in structure it seems to be intermediate between that of modern man and Sinanthropus.

Weidenreich points out that in modern man the crown of this premolar is much higher relatively than in Sinanthropus. Our Plesianthropus tooth is not old enough for us to say exactly how high the crown would become, but in general proportions it agrees much more closely with that of Sinanthropus than with that of modern man.

In typical anthropoids from Propliopithecus to the living Gorilla the 1st lower premolar is a unicuspid tooth with frequently a trace of an inner cusp, but apparently never with any but a small inner cusp. Of course, if we had a hundred jaws of Propliopithecus we might find a tooth with a fairly well developed inner cusp. There seems to be an inner cusp in its smaller contemporary, and not very distantly removed cousin, Parapithecus; and we may assume as highly probable that the early Old World Monkeys had bicuspid premolars. And if the generalised Catarrhines had bicuspid 1st lower premolars we could readily believe that three lines had evolved from them. First, the typical Cercopithecids, in which the tooth became flattened and developed a large anterior cutting

plate in the males; a second line where the tooth became flattened, but did not develop any great cutting edge in front; and third a line in which the tooth remained a bicuspid tooth, such as we find in Plesianthropus and man. However the teeth evolved, it will be manifest that the 1st lower premolar closely resembles that of man in structure, and has no near resemblance to that of any of the anthropoids — not even to that of Propliopithecus.

The following are the principal measurements: — antero-posterior length of crown 9.4 mm.; transverse width 10.1 mm. It must not be forgotten, however, that this crown is only a developing germ, and that the adult fully formed tooth must be appreciably, but not very greatly, larger, as the enamel grows in thickness.

The 1st lower permanent molar is perfectly preserved and almost unworn. It agrees pretty closely with the corresponding molar in man and in Australopithecus, and is not very unlike that of the Chimpanzee. There are five well marked cusps. In front of the two anterior cusps there is a well marked fovea, and between these anterior cusps there is a distinct sharp furrow. The two main posterior cusps are not unlike the anterior in size and structure, and the fifth cusp is only a little smaller. In the outer view, which we give, the three outer cusps are seen sharply divided in their upper halves from each other. On the outer side of the antero-external cusp there is the faintest indication of a cingulum, but between this cusp and the one behind it there is no pit very clearly differentiated.

The general structure of the tooth is shown in the figure given. The following are the principal measurements: Greatest antero-posterior length 13.3 mm. and greatest width, which is across the posterior cusps 11.3 mm.

We have the complete permanent dentition of the male lower jaw, but unfortunately the teeth are all much worn.

The incisors are remarkably small considering the size of the jaw. The two 1st incisors are both worn down to near the base of the crown. The measurements at the base of the crown are 7 mm. by 4.3 mm.

The 2nd incisor is considerably larger than the 1st. Unfortunately the crowns have been damaged in the teeth of both sides. They are both much worn down. The basal measurement of the crown is 8.5 mm. by about 6 mm.

The canine crown is much worn down, but otherwise is perfect. The horizontal plane to which it is worn down is 4.7 mm. above the base of the crown at the outer side. The section of the crown which the wearing has produced is an irregular broad oval measuring 10.7 mm. by 8.8 mm. The worn enamel is seen right round the crown. On the lingual side there is a little patch of enamel which appears to represent what may be the base of an infolding. And on the anterior part of the lingual side there has been a flattening of the enamel which is perhaps the remains of an anterior hollowing. Round the lower part of the crown on the buccal surface there is a thickening of the enamel, which might be regarded as a rudimentary cingulum.

The 1st premolar is worn down almost to the base of the crown. Only the enamel of the buccal and lingual sides remains. On the outer side there are clearly two roots of which the anterior is the larger, and on the lingual side there is a large single root. Whether all these three roots are distinctly separated cannot be seen Possibly all three are distinct. The presence of three roots on the 1st premolar is of course not a human

character, but neither is it anthropoid. In man in the large majority of cases the 1st premolar has a single root, but not infrequently there is an indication of two roots, while two roots is the general condition in the anthropoids, and in the Baboon. It seems possible, judging from the photographs, that Propliopithecus has a 3 rooted 1st premolar. While in man the two roots, if present, are an inner and an outer; in anthropoids it is an anterior and a posterior.

The greatest diameter of the crown from the anterior part of the buccal side to the back of the lingual is 13.4 mm. and across the middle part of the tooth, which is really below the crown, 7.4 mm.

The 2nd premolar is almost as badly worn as the 1st. In occlusal view the crown has a broad oval surface. Enamel runs round the tooth, and a little behind the middle of the lingual border a little flat part of enamel passes outwards over the dentine. This little flat part of enamel doubtless represents part of the posterior depression behind the main inner cusp. The greatest oblique length of the crown measures 13.4 mm. and the width across the inner part is 9.8 mm. — which is probably the same as the median measurement was before being ground down.

As in the 1st premolar there are two outer roots, clearly seen in the tooth of the right side, but these are about equal in size, and there is a large inner root. Without breaking into the tooth it cannot be said whether these roots are fully separated from each other, but very possibly they are. In the female premolars previously known there are two flattened roots.

The 1st lower molar is completely ground down to the dentine of the outer roots, but a considerable part of the lingual enamel still remains. When the tooth is viewed from the outside the buccal side of the tooth is seen to be worn down 7 mm. below the level of the inner side. Clearly the wearing must have been by an antero-posterior movement of the jaw resulting in the outer half of each molar being much more worn than the inner.

As half the enamel crown is gone it is impossible to give the width before wearing. It probably was about 12.5 mm. but may have been as much as 13.5 mm. The antero-posterior measurement is about 11.3 mm.

On the lingual side the enamel is deeply folded in between the two inner cusps as shown in the figure. The two outer roots diverge considerably.

The 2nd molar is much larger than the 1st and is ground down in almost exactly the same way, but not to the same degree. On the buccal side there is seen the basal part of the enamel. On the lingual side there are three infoldings of enamel. In front is seen part of a small infolding which doubtless represents part of the enamel of the base of the anterior fovea. Near the middle of the lingual border is a large infolding between the two large inner cusps, and posteriorly there is a thickening of the enamel which represents the enamel of the posterior fovea.

The greatest antero-posterior length of the tooth of the left side about the median region is 14.5 mm., and of the right side tooth 15.2 mm. The greatest width of the left tooth is about 14.7 mm. and that of the right side 15.1 mm.

The very badly worn 2nd lower molar, described by Broom in 1946, had a crown measuring somewhat over 17 mm. by 15.5 mm.; which makes us suspect that some males of Plesianthropus were possibly even larger than the owner of this very large jaw.

The 3rd lower molar is about as large as the 2nd, but it has not been quite so deeply ground down. More of the enamel remains on the lingual side, but between the flat ground down enamel of the inner side and the bordering ring of enamel on the outer there is a very deep grinding out of the dentine, the lower part of the hollow being 4 mm. between the level of the inner plate of enamel.

The greatest antero-posterior length of the tooth is 15.5 mm. on the left side. The greatest width of the tooth is 14.6 mm. The right 3rd lower molar crown cannot be fully displayed as it mainly lies under the crushed anterior part of the ascending ramus.

The huge premolars and molars of this jaw bear very little resemblance to those of the Chimpanzee, or indeed to those of any of the anthropoids, and the mode of wearing is entirely different.

FIG. 16.— Upper left deciduous molars of various higher Primates. A. Young Orang. B. Young Chimpanzee. C. *Plesianthropus transvaalensis* (Broom). D. Bushman child; a little over a year old. All figures twice natural size.

UPPER DECIDUOUS DENTITION.

WE ARE FORTUNATE in being able to give some account of the upper deciduous dentition in Plesianthropus, and a complete account of the lower.

We have only one specimen showing the upper milk molars. It is the fragmentary snout of a young child in which the 1st milk molar is considerably worn, and the 2nd functioning but only slightly worn. The teeth may thus belong to a child corresponding in age to a human child of 5 years.

We have a very considerable part of the left maxilla and a smaller part of the right. Unfortunately though we have much of the facial surface of the left maxilla with the infraorbital foramen, and part of the malar we have not sufficient of the anterior part to show whether there is any evidence of a maxillary-premaxillary suture. We have however much of the developing germs of the permanent premolar crowns, and with the tip of the developing canine which we have already described.

The crown of the 1st deciduous molar is a molariform tooth essentially similar to that of man. On the outer side are two well developed cusps with a small anterior cusp. The main cusp is worn down to the dentine. On the inner side of the occlusal surface is a large low cusp which has been even more worn than the main outer cusp and a considerable portion of the dentine is showing. Posteriorly on the crown there is besides the well developed outer posterior cusp a small but distinct low inner posterior cusp.

The whole occlusal surface is thus made up of four well developed cusps and a small anterior 5th.

The second deciduous molar is not unlike the first. It is considerably larger but there is no distinct anterior cusplet developed. The occlusal surface is roughly rhomboidal. The anterior outer cusp is low and rounded, and it has two furrows running into it — one on the inner side and one on the posterior. The antero-inner cusp is much the largest cusp. It is also low and rounded. On its anterior and inner side is a marked groove, and in front of this quite a distinct Carabelli cusp, as shown in the figure. The two posterior cusps are also low cusps and are subequal in size. In the back part of the crown is a definite fovea.

The following are the principal measurements of the teeth: — 1st upper deciduous molar — length from anterior cusplet to middle of posterior side 10.5 mm., greatest width 9.8 mm.; 2nd upper deciduous molar — greatest length, near middle line, 11.3 mm.; greatest width 11.4 mm.

In man the 1st deciduous upper molar varies considerably in structure and is generally somewhat degenerate. In the book on "The South African Fossil Ape-Men." Broom figured the deciduous molars of a Bush child which agree remarkably closely with those of Australopithecus. Here we figure (fig. 16) the deciduous molars of another Bush child, where they are a little smaller, and slightly different in shape.

The Bush 1st deciduous molar here has the small anterior cusp fairly well developed and differently shaped from the other, and the posterior cusps are relatively smaller. The 2nd deciduous molar has, as in the one figured in the book, a small but distinct Carabelli cusp.

When these Bush teeth are compared with those of Plesianthropus it is seen that they are essentially similar in the two types. In fact the two Bush 1st molars differ a little more from one another than does one of them from the Plesianthropus tooth.

When we compare the Plesianthropus upper deciduous molars with those of the anthropoid we are at once struck by the essential difference of the 1st deciduous molars. We here give drawings of the milk teeth of an Orang and of a Chimpanzee (fig. 16). They are quite typical of the only specimens we have at hand (6 young Chimpanzees and 2 young Orangs). If we had a hundred young skulls to examine it is possible that we might find some specimen which still retained rudiments of the ancestral posterior cusps. If such do occur they must, we think, be rare.

The Chimpanzee 1st deciduous molar has two well developed cusps with a deep hollow between them and no trace of any posterior cusps. There is, however, what may be a rudiment of an anterior.

In the Orang this 1st molar is also a bicuspid tooth with no trace of posterior cusps, and just a suggestion of the anterior small cusp.

The 2nd deciduous molar of the Chimpanzee and the Orang resemble much more those of Plesianthropus and man. There are in each four well developed low cusps. There is however one point in which they differ, but this is a character of probably no great importance. Each has a distinct anterior fovea, while in Plesianthropus it is hardly developed.

If the teeth of Plesianthropus be compared with those of Australopithecus it will be seen that while there is essential agreement there are a number of important differences. The Australopithecus teeth are a little more worn. They are slightly smaller. In the 1st tooth there is in Plesianthropus a little hollow corresponding to the Carabelli pit. There is hardly a trace of this in Australopithecus. In the 2nd tooth while there is a Carabelli cusp in Plesianthropus, there is not even a pit in Australopithecus. Further there is a very distinct posterior fovea in Plesianthropus, while there is no trace of it in Australopithecus.

It is unfortunate that no upper deciduous molars are known of Sinanthropus, nor indeed of any fossil ape or early man.

LOWER DECIDUOUS DENTITION.

THE CHILD Plesianthropus lower jaw, found on 11th March, 1948, gives us examples of all the lower milk teeth. As already mentioned the bone is hopelessly imperfect. Presumably it had been chewed by some carnivore before it was fossilised, so that very little of the bone remains. Fortunately, the two right milk molars with the 1st right permanent molar are in undisturbed position. The right milk canine is badly displaced and the right incisors slightly displaced. The left 1st and 2nd incisors are preserved with the left canine together, and only a little displaced; and the left 1st deciduous molar is also preserved. As the incisors and canines are small and apparently rather fragile, their lingual sides have not been completely cleaned out.

FIG. 17.— Right lower milk molars and 1st true molars of various higher Primates. All figures twice natural size. A. *Paranthropus robustus* Broom. B. *Australopithecus africanus* Dart. C. *Plesianthropus transvaalensis* (Broom). D. *Homo sapiens* Linn. Bushman. E. *Pan* sp. Chimpanzee.

The 1st deciduous incisor is a very small tooth, and the cutting surface is a little worn. If crenulations were present originally they have disappeared. The buccal face of the tooth is slightly convex and smooth (Fig. 15A).

The following are the measurements of the crown:— Width of cutting edge 4.1 mm. The depth of crown on buccal surface is 4 mm.

The tooth is a little more robust than that of the modern human child, and the crown much lower, but this may be due to attrition. It agrees very closely with the corresponding tooth of Sinanthropus figured by Weidenreich (Sinanthropus 118). The corresponding tooth in Australopithecus is not sufficiently well preserved to make a satisfactory comparison. The teeth are apparently essentially similar. No attempt has been made to clean the lingual side, which would be very difficult.

The lateral incisor is perfectly preserved except that the top of the crown is a little worn. The crown is about a half larger than that of the median incisor, and it differs in that the outer half of the cutting edge slopes considerably downwards (Fig. 15B).

The following are the principal measurements: — Greatest width of crown as preserved 5.5 mm., depth of enamel as preserved on buccal side 6.7 mm.

As no corresponding tooth is known in Sinanthropus no comparison can be made.

The deciduous canines of both sides are preserved, and the crown of the left one is perfect except for a little wearing. The buccal view is very remarkable. The outer face is fairly long and there is a well developed point or main cusp. In front there is a small but quite distinct anterior cusp as shown in the figure, and from the hollow between this small cusp and the main part of the tooth there is a well marked groove passing downwards parallel to the edge of the tooth. On the posterior side of the crown there is also a small cusp which is a little worn and thus less distinctly differentiated from the main part of the tooth, and from the hollow between this posterior cusp and the rest of the crown there also runs down a groove a little less marked than the anterior groove (Fig. 15C).

On the lingual side there is a well marked ridge running down from the point of the tooth to near the base of the crown. Between this ridge and the anterior cusp there is a very distinct groove, and between the median ridge and the posterior cusp a less developed groove.

The posterior little cusp was probably quite a well differentiated cusp before it was ground down. The whole of the posterior upper border of the tooth, from the point of the main cusp to the base of this little posterior cusp, has been partly ground off by attrition, and this must have been by the front of the upper canine. We thus find in this meeting of the canines exactly what has happened with the permanent canines. Instead of passing outside the lower canine the upper has apparently ground against the back of it, until the two canines had their occlusal surfaces biting against each other. This is what has happened in Propliopithecus, where the upper canine manifestly met the back of the lower.

Though three cusps on the milk lower canine are unknown in the anthropoids, clear indications of the three cusps are not uncommon in the milk lower canines of at least Bantus, and there is also some indications of both an anterior and a posterior cusplet in Colobus. In Australopithecus the canine is considerably worn, and though there is no indication of an anterior cusp there is clear indication of a small posterior.

As preserved, the lower canine crown measures in greatest height on the buccal surface 7.8 mm, and the greatest width is 7 mm. Before wearing both of these were slightly more. The height of the crown was probably 8.5 mm.

The most important tooth in the lower deciduous dentition, from the morphological point of view, is undoubtedly the 1st molar. Fortunately in this Plesianthropus child lower jaw we have the perfect right tooth and the nearly perfect left one.

The tooth when viewed from above is a broad oval. It is considerably worn and a good deal of the dentine shows. In the front half of the tooth there are manifestly two well developed cusps. The outer one is worn sufficiently to show an oval patch of dentine, and the inner a small rounded patch. These are the two main anterior cusps — the ones usually called the protoconid and the metaconid. In front of the antero-inner cusp is a shallow fovea. In the posterior half of the crown there is a large exposed surface of dent-

tine, consisting of the worn bases of the large postero-external cusp " hypoconid ", the posterior or 5th cusp " mesoconid ", and the postero-internal cusp the 4th or " entoconid." When viewed from the outer side the outer cusps are seen to be much worn, and the antero-internal cusp only slightly. There is a marked cleft between the two large outer cusps.

When this tooth is compared with the corresponding one of Australopithecus the agreement is seen to be close. Each has the same cusps and each is worn down in similar fashion. A comparison with the corresponding tooth in Paranthropus shows a very marked difference in structure. The difference is so marked that it will probably be necessary to place Paranthropus in a different sub-family. Though the mandible of the young child Paranthropus was found very close to the type adult skull there is no proof, but only a very strong probability, that it belongs to Paranthropus. It is manifestly the jaw of a child of a large primate, and clearly does not belong to Plesianthropus or man. We may thus conclude that it almost certainly belongs to Paranthropus. There are four subequal well developed cusps with a small fifth posterior one, and a well marked anterior fovea. Paranthropus we know has a smaller canine than Plesianthropus, and the regular shape of the milk premolar has probably been developed in correlation with the smaller canine.

When we compare the 1st lower deciduous molar of Plesianthropus with the corresponding tooth in the human child, we are surprised to find the Plesianthropus agrees with man very closely — much closer than it does with Paranthropus.

In man this anterior milk molar shows much variation. Broom, in his book on " The South African Fossil Ape-Men ", has given figures of a Bushman tooth which is almost identical with that of Australopithecus and very similar to that of Plesianthropus, and of a Bantu milk tooth which, though essentially similar, differs in a number of details. Herewith we give other examples of Bush milk teeth (fig. 17).

The series of teeth placed beside the Plesianthropus teeth shows interesting comparisons. There is a little difference in size and details, but no essential difference in structure. We also give a drawing of the milk lower molars of another Bush child. These are from a baby of about a year old (Fig. 18). The germs are not fully formed, and smaller than they would be when completely grown. The anterior part of this 1st milk molar shows a broad sharp-edged antero-external cusp (protoconid) and a high round pointed antero-internal cusp (metaconid). In front there is a deep fovea. The posterior half of the tooth has a moderately well developed postero-external cusp (hypoconid), a fairly well developed postero-internal cusp (entoconid), and a small posterior cusp (mesoconid). Probably in later development it would be broader, and not unlike the other Bush 1st milk molar here figured.

When we compare the Plesianthropus tooth with the corresponding tooth in Sinanthropus, we see that there is a fairly close agreement. Weidenreich figures and describes two examples, one much worn (No. 121) and the other slightly worn (No. 125).

The worn tooth is smaller and narrower than in Plesianthropus, but agrees in essentials. It differs in having evidence of a slightly developed outer cingulum. The slightly worn example is also a narrower tooth but it is longer than in any of our South African types. There is also a well developed postero-external cusp (hypoconid).

If we compare the Plesianthropus 1st lower deciduous molar with those of the living anthropoids, we are rather startled to find that there is really no close resemblance whatever. Broom called attention to this in 1946. He said:— "The milk teeth of man and those of Australopithecus are practically identical in structure, though this close resemblance may in part be due to both being primitive. The type is quite different from that found in the Chimpanzee and Gorilla, and while the anthropoid type could be evolved from the hominid type there seems no possibility of the hominid type having been derived from the anthropoid type." He gave figures of the lower milk molars of the Orang, the Chimpanzee and the Gorilla.

In the gorilla we find the tooth is a flattened sectorial tooth with only one large cusp developed, and this corresponds to the antero-external cusp of man (the protoconid). In the Chimpanzee we find a fairly similar tooth, but it differs in generally having a trace of the antero-internal cusp (metaconid) usually developed so closely to the main cusp as practically to be part of it. In the Orang the condition is almost the same as in the Chimpanzee, but the antero-internal cusp is a little better developed. In the Gibbon the condition is essentially as in the Orang.

FIG. 18.—The 1st and 2nd lower right deciduous molars of various Primates. A. Germs of a baby Bushman of about 1 year old. B. Slightly worn teeth of *Limnopithecus legetet* Hopwood. Drawing from cast of left teeth, reversed. C. Worn teeth of *Sinanthropus pekinensis* Black. After Weidenreich. All figures twice natural size.

Though we know many fossil anthropoids, only one fossil of an anterior lower deciduous molar of an anthropoid has ever been discovered. This is the milk tooth of the little East African anthropoid *Limnopithecus legetet*, described by Hopwood in 1932. We know that Limnopithecus, Xenopithecus and Proconsul are fairly closely allied anthropoids, and we know that they are moderately closely related to the Chimpanzee, though being Lower Miocene types they are more primitive in quite a number of characters. And the structure of this little milk tooth is thus of the utmost importance in determining the phylogeny of the anthropoids and man. If this little tooth proved to be a molariform tooth with a cuspid talonid, then it would probably be near to the origin of man, or at least near the human line of descent. If it proved to be a tooth like those of the Orang or Gibbon, then we would seem compelled to derive man from a pre-Limnopithecus.

Arambourg in "La Genèse de L'Humanité" (1943), believes that the Limnopithecus milk molar is a molariform tooth, and thus places Limnopithecus in the human line. Not being able to see the original tooth, Hopwood has most kindly sent us a cast; and though the tooth is a very small one the cast is remarkably good. We give a drawing of what appears to us to be the structure of the tooth (fig. 18b). There is clearly a large antero-external cusp (protoconid) and a smaller cusp on its inner side (metaconid), and there are apparently no other cusps developed. Pretty manifestly there are no cusps developed in the talonid which is a flattened part as in the Orang. It thus seems to us that the Limnopithecus tooth is of a primitive anthropoid type, and that thus Limnopithecus cannot claim to be on the human line of descent.

So constant is the molariform type of milk molar among men of all races, and among the Australopithecids, and so constant the sectorial type in the living anthropoids and a close approach to it in the only known fossil anthropoid tooth, that we consider this tooth alone is sufficient to divide man and all his allies from all the anthropoids.

From what we know of the Lower Miocene anthropoids, Proconsul and its allies, we see that there has been no important change in the dentition for 15 or perhaps 20,000,000 years. And the little jaw of Propliopithecus shows that there has been very little change even since Lower Oligocene times. Propliopithecus has a pointed 1st lower premolar, and if we could get a 1st lower milk molar it seems likely that it would also be of the anthropoid type, or intermediate between that type and the molariform type found in man.

Here are the principal measurements of the 1st deciduous lower molar in Plesianthropus:— Antero-posterior length 8.2 mm.; greatest width 7.3 mm.

The second diciduous lower molar of Plesianthropus is as perfectly preserved as is the first, and it is only a little worn. The two outer main cusps (protoconid and hypoconid) are about equally well developed. In each the dentine is exposed, and between them there is a marked furrow on the outer side, but no distinct pit. In Australopithecus there is a well developed pit, and a bar of enamel forming a sort of cingulum below it. The posterior cusp (mesoconid) is small and there is in Plesianthropus no 6th cusp, as there is in Australopithecus. As we have only the right and left teeth of one jaw we cannot say how variable it may be. The two internal cusps are well developed. They are essentially similar to those in Australopithecus and man, and not very different from those in the Chimpanzee.

The tooth is smaller and considerably narrower than in Australopithecus. From the Paranthropus corresponding tooth the differences are very marked as will be observed if the figures given are compared.

The following are the principal measurements of this 2nd lower milk molar. Greatest antero-posterior length 10.8 mm., and greatest width across posterior cusps 9 mm. In Australopithecus similar measurements are 11.7 and 11.5 in length, and across the posterior cusps 10.7 and 10.8 mm.

If we only had the lower milk molars and the 1st true molar we might conclude that *Plesianthropus transvaalensis* belonged to another species of Australopithecus, the resemblance is so close in general structure. But the remarkable fact that the milk lower

canine has a small anterior cusp, which does not occur in Australopithecus, seems to justify the placing of the Sterkfontein ape-man in a distinct genus. And the geological age must be very different, as no species of fossil mammal is common to the two deposits, Clearly, however, the two forms belong to the same sub-family, and the resemblance of the dentition to that of man makes it highly probable that the human ancestor belonged also to this family. In our opinion the human race cannot be at all closely allied to the higher anthropoids.

FIG. 19.—A. Imperfect right scapula of *Plesianthropus transvaalensis* (Broom). B. Lower end of right scapula of male Bushman. C. Lower end of right scapula of very large old male Orang. All figures two-thirds natural size.

SCAPULA AND HUMERUS.

WE HAVE FORTUNATELY found a considerable portion of a scapula. It belongs to the same skeleton as the large male lower jaw. With it was also found much of the humerus and one good vertebra and some unsatisfactory rib fragments.

The scapula is crushed, and has lost the lower and inner half. Still we have the whole of the glenoid region, with the perfect coracoid and a considerable part of the spine; but the spine is crushed, and the distal end of the acromion is lost.

The glenoid cavity resembles that of man to some extent. Its greatest length is about 33 mm. and the greatest width is 20 mm. In front it differs from that of man in there being a much greater development for the attachment of the biceps. In this character it more resembles the Orang. In man the coracoid process passes off from a little behind the plane of the glenoid. In the Plesianthropus scapula it passes out practically from the bicipital tuberosity and then curves backwards much more than in man. In this it also resembles the condition in the Orang more than in man. A comparison of the figures will show how the structure is not quite human, and a little like that of the Orang.

Though the coracoid is a little like that of the Orang in its attachment to the scapula it resembles that of man in being rather slender, but differs in having its distal end curved backwards rather than forwards.

On the upper border of the scapula there is no distinct suprascapular notch, and in this character also the resemblance is rather with the Orang than with man. There is thus no very distinct neck to the scapula.

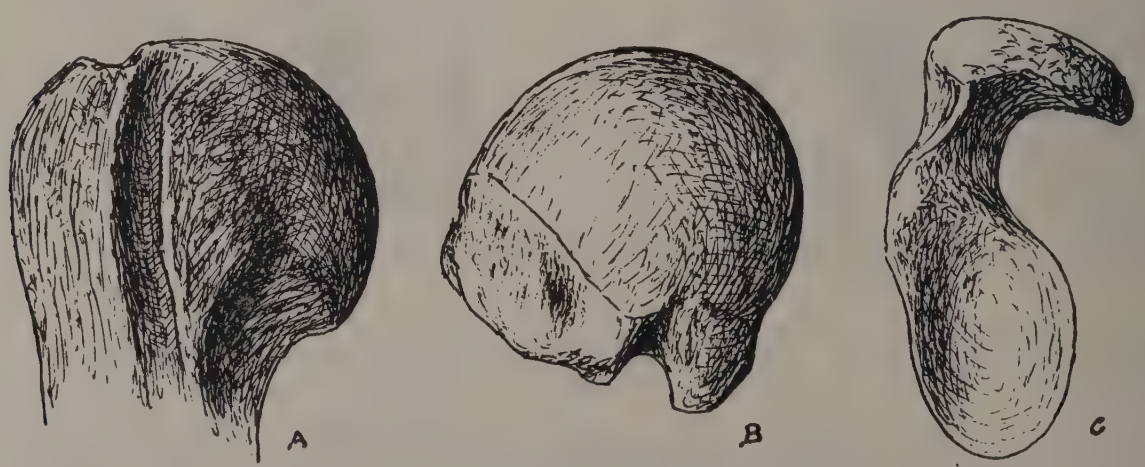

FIG. 20.— A. Anterior view of upper end of right humerus of *Plesianthropus transvaalensis* (Broom). B. Upper view of upper end of right humerus of *Plesianthropus transvaalensis* (Broom). C. Glenoid cavity and coracoid process of right scapula of *Plesianthropus transvaalensis* (Broom). All figures natural size.

The spine though imperfect can be restored with some confidence, and it appears to be more like that of man than that of the Orang.

The lower border of the scapula near the glenoid cavity is more like the Orang condition than the human.

Many years ago T. H. Huxley commented on the fact that in the Orang "the scapula, on the whole, bears a greater resemblance to that of man than it does in either the Chimpanzee or Gorilla." And this has been confirmed by both Vrolik and Mivart. So it is not surprising to find that in Plesianthropus the resemblance to the Orang is about as marked as that to the human scapula. We might say that in general structure the scapula is about intermediate between that of the Orang and that of man.

It is unfortunate that we do not know the scapula in any fossil anthropoid or in any fossil early man. And, as we have only this one imperfect specimen of the Plesianthropus scapula, it is hardly advisable to discuss at further length its structure or affinities.

The humerus, that belongs to the same individual as this scapula, has the head and the greater part of the shaft preserved. The head is perfect; but almost immediately below the neck the shaft is crushed nearly flat. A little lower down it has been broken across and badly crushed, and the distal end is lost. Though we have thus about three quarters of the humerus preserved, it is only the head that is worth describing.

In general structure the head is almost typically human. The rounded articular surface is part of a sphere which has a diameter of about 40 mm. The bicipital groove is large, and passes straight down the shaft from near the upper end of the bone. This is as in man, and differs considerably from the condition in the Orang, but agrees fairly well with the structure in the Chimpanzee and Gorilla.

The lesser tuberosity is very well developed, and forms the inner wall of the groove. It forms a very prominent ridge that runs down the shaft for a distance of about 40 mm., and it is more prominent than in any human humeri we have at hand. Between this lesser tuberosity and the lower third of the articular surface there is a marked hollow, so that the lower third of the tuberosity is a rather narrow well developed ridge. In none of the three large living anthropoids does the tuberosity form a ridge running straight down the shaft. In all three it curves inwardly away from the groove and is relatively shorter; and in none of the living large anthropoids is there as deep a hollow on the inner side of the tuberosity.

The greater tuberosity is not unlike the human type. When viewed from above it is seen to be in shape more like that of man than that of the Chimpanzee or Gorilla; but it bears a distinct resemblance to that of the Orang. On the outer side the articular surface for the teres minor is very distinct, and below this the bone has a prominent ridge; but this may be due to the crushing of the shaft.

The lower third of the humerus, as preserved, is uncrushed, but it cannot be easily removed without damaging a vertebra that lies against it. This portion of the shaft is very strongly developed as we might expect in a large male.

Though the distal quarter of the bone is lost we can form a fair estimate of how much is gone. We can be moderately safe in considering that the whole humerus was about 300 mm. in length. It cannot have been less in our opinion than 290 mm., nor do we think more than 310 mm. This is a little longer than the usual length of the Chimpanzee male humerus, and a little shorter than the humeri in large human males.

PELVIS AND FEMUR.

WE HAVE BEEN FORTUNATE in discovering the nearly complete pelvis of Plesianthropus. It was blasted out on 1st August, 1947. With it were found much of one femur with the shaft rather badly crushed and the lower end missing. The upper end is fairly well preserved. We also have a considerable part of a tibia, but in very bad preservation, and we have numerous fragmentary and crushed ribs, and a small part of a badly crushed skull and a few vertebrae. No attempt has as yet been made to clear out the vertebrae as it could hardly be done without running considerable risk of damaging the pelvis.

Of the pelvis, the right ilium is almost perfect, except that a part of the anterior end is lost. It had probably been chewed off before fossilisation. It was at first thought possible that the truncated anterior end might be the natural condition, as there is no clear evidence of a fracture. Fortunately much of the left ilium is also preserved in which the anterior end is almost perfect.

FIG. 21.—Right os innominatum of *Plesianthropus transvaalensis* (Broom). Two-thirds natural size. A. Front view at right angles to main plane of ilium. B. Posterior view at right angles to main plane of ilium. C. View of acetabulum with lower parts of ischium and pubis restored in position.

Apart from the missing anterior part the right ilium is perfect to the acetabulum, and the acetabular portions of both pubis and ischium are also perfectly preserved. About 15 mm. below the edge of the acetabular border the pubis has been broken across and crushed back, but the lower part of the pubis is preserved and the displacement can be satisfactorily restored as no part seems lost. The ischium has been broken across below the ischial tuberosity and slightly crushed back, but otherwise it is satisfactorily preserved.

We can thus by adding the anterior part of the ilium from the left bone, and restoring into position the slightly crushed and displaced portions of the pubis and ischium make a satisfactory drawing of the whole os innominatum.

At first sight the ilium looks almost human, especially as found with the anterior end lost, and we believe opinions have been expressed that this pelvis might be human. But when the whole pelvis was cleaned out and restored this was seen to be quite impossible.

It is at present difficult for us to make any lengthy comparisons of the pelvis with those of different human races or with the various anthropoid and other apes. The pelvis alone calls for a large and special monograph; but this must come later.

The ilium is very unlike that of any anthropoid or even any Old World Monkey. It is very broad and instead of extending well above the sacral articulation it passes mainly outwards.

The iliac crest is essentially similar to that of man; but the anterior superior spine extends relatively farther forward and the top of the crest is a little more horizontal than in most human pelves. The posterior and inner half of the flat part of the ilium is remarkably like that of man. There is a posterior superior spine and a posterior inferior spine just as in man, indeed the condition is not unlike that of the Bushman. The front of the ilium is flatter than in most human pelves, and the rounded ridge that runs upwards and forwards in man, to a point about 25 mm. above the anterior superior spine, runs more forwards and curves round towards the spine.

The measurement from the anterior superior spine to the posterior superior spine is about 115 mm., and from the edge of the acetabulum to the most distant part of the iliac crest, above the posterior superior spine, the distance is 90 mm.

The anterior inferior spine resembles that of man very considerably, but differs in one very important character which does not occur in man so far as we know. In man the sharp margin of the acetabulum runs right round above the articular hollow to a depression in the neighbourhood of where the ilium meets the pubis. In Plesianthropus the condition is different. The acetabular border runs round to the base of the anterior inferior spine and practically ends in the lower part of the oval spine. Then another little ridge bounds the anterior part of the acetabulum and is continued round as the pubic portion of the acetabular margin. Thus the upper part of the acetabular ridge runs upwards and forwards to form the base of the spine. In other respects the acetabulum agrees closely with that of man. The acetabular notch is essentially similar to that in man, but it is relatively narrower than in at least the Bushman. The acetabular fossa is also like that of man.

The internal surface of the ilium is a little like that of man, but here there are some important differences. The articular surface for the sacrum is very much smaller

than in man, and the part above for the sacral ligaments is also smaller, while the iliac surface is much larger. Roughly in man the iliac fossa forms about 4/7 of the surface of the upper half of the inner side of the ilium. In the Plesianthropus ilium the iliac fossa forms about 5/6 of the ilium above a line drawn from below the sacral articulation to below the anterior superior spine. The surface also passes backwards above the rough markings for the sacral ligaments as if the iliacus also passed backwards above the sacrum.

FIG. 22.— The right ossa innominata of higher Primates. A. Os innominatum of *Plesianthropus transvaalensis*. B. Os innominatum of large male Chimpanzee. C. Os innominatum of Bushman male. All figures are similarly orientated in plane of ilium. All are one-third natural size.

The sacral articulation is perfectly preserved, and is remarkably interesting. It is essentially like that in man, but very much smaller than in the Bushman. The antero-posterior length of the articulation in a small male Bushman is 53 mm., and the height of the articular surface above a line along the base is 38 mm. In the Plesianthropus ilium the greatest length of the articulation is only 29 mm. and the height 26 mm. Further the sacral articulation in man makes an angle with the general plane of the ilium of about 30°, but in the Plesianthropus pelvis the articulation is considerably more on the inner and posterior part of the ilium, and it makes an angle with the general plane of the ilium of about 45°. In fact the posterior third of the articulation may be said to be on the posterior and inner end of the ilium. The sacral articulation may be described as in two parts. The anterior portion which manifestly articulates with the first sacral vertebra is only about half the size of the corresponding part in the Bushman. The posterior part is only a little smaller than the corresponding part in the Bushman and most probably articulates only with

the 2nd sacral vertebra. Between the two parts there is a marked elevation as shown in the figure. A similar elevation is seen in some human pelves, but less marked.

The ischium is completely preserved, and is only imperfect in having been crushed and a little displaced below the obturator foramen. The acetabular portion is almost exactly as in man, but appreciably smaller. The surface behind the acetabulum is almost typically human, and there is a well developed pointed ischial spine. When we examine the tuberosity of the ischium, however, we find a marked difference from that of any human pelvis we have at hand. In man there is a large irregular oval boss which gives attachment to the semimembranosus, biceps femoris, and semitendinosus muscles. This irregular elevated rounded surface extends upwards to near the acetabular border, there being usually a rather deep narrow surface between the two structures.

In Plesianthropus this portion of the ischium differs markedly. The ischial tuberosity is here a rather small flattened irregular surface. It is only 15 mm. wide at its widest part, and the length of the tuberosity is 35 mm. At its upper end there is a small rounded knob, but below this most of the tuberosity is moderately flat. The most striking character is that this tuberosity is well removed from the margin of the acetabulum, the distance between the two being 16 mm. The lower part of the ischium is flattened out as it forms the lower part of the ring of bone surrounding the obturator foramen. This part of the ischium is differently shaped from the condition we see in at least the Bushman, as will be seen from figure given.

The pubis in general structure is essentially human. As has been said the acetabular portion though smaller closely resembles the human structure. From the acetabular portion there passes forward and inwards to the symphysis a part which is rounded above in the part near the acetabulum but broadens out almost exactly as in the Bushman as it comes to the symphysis. The symphysis is crushed a little but nearly perfect, and seems to be almost as in man but flatter. The part of the pubis below the obturator foramen is moderately wide, and the whole obturator foramen extends more downwards than in man.

The whole pelvis is thus essentially like that of man, but it differs in a number of important points. The ilium has the anterior superior spine developed more forwards. The anterior inferior spine differs in being continued on to the acetabular surface. The ischium has a tuberosity which is not quite human, and which is farther removed from the acetabulum than in man. And the obturator foramen extends more downwards than in man.

There is little agreement with the pelves of either the anthropoids or the old world monkeys. No one who studies this pelvis can longer hold we think, that Plesianthropus is either a Chimpanzee or a Gorilla, or can be closely allied to either. Of the three large anthropoids the Orang seems to come nearest but the resemblance is not at all close.

There is one very important character in which this pelvis differs from that of man, namely in the orientation. In man the iliac crest is directed slightly outwards but mainly forwards. In the Plesianthropus pelvis the crest is directed as in the anthropoids, mainly outwards but somewhat forwards. A figure is here shown of the three pelves drawn at right angles to the main plane of the upper part of the ilium. In the Chimpanzee the symphysis is shown behind, well to the left. In man a similarly arranged drawing shows the symphysis very much to the right. In Plesianthropus the symphysis is a

little to the left. We might thus say that the ilium is almost like that of man, but that the pubis and ischium resemble more those of the Chimpanzee. In the Chimpanzee pelvis in this view the inside of the acetabulum is not at all seen: in man much of the acetabulum is seen: but in the Plesianthropus pelvis only a little of the acetabulum shows.

In the interesting paper by Straus on the ilia of the primates he says:— "The human ilium would seem most easily derived from some primitive member of a pre-anthropoid group . . . . The anthropoid ape type of ilium is in no sense intermediate between the human and lower mammalian forms. Its peculiar specialisations are quite as definite as those exhibited by man, so that it appears very unlikely that a true anthropoid ape form of ilium could have been ancestral to the human type."

This conclusion of Straus is interesting as confirming the evidence from the dentition.

Lying beside the pelvis was much of the left femur. Most of the upper two thirds of the bone is present, but rather badly crushed, and for the most part most of the surface is not sufficiently well preserved to show satisfactorily the muscular ridges. It seems unwise to describe this badly crushed femur in detail as the California University Expedition has found the beautifully preserved upper third of a femur apparently of an Australopithecid from a deposit at Sterkfontein, about a couple of miles from the caves where we are working. We have seen this specimen before it was cleared of matrix; but, as Prof. Camp or one of his assistants will doubtless be describing it in detail, we do not feel at liberty to say anything more about it.

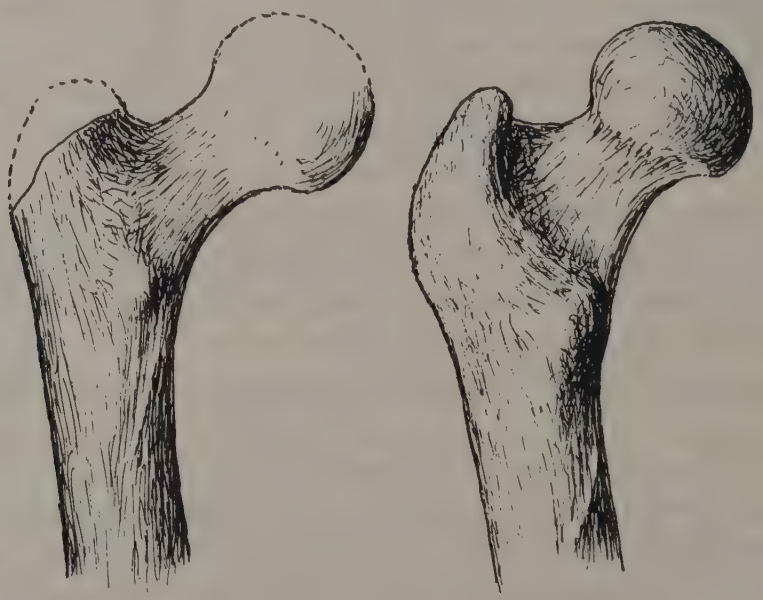

FIG. 23.— Posterior view of left femur of A. *Plesianthropus transvaalensis* (Broom). and B. Bushman. Both two-thirds natural size.

There are one or two points about our femur that we might call attention to. The top of the great trochanter is lost, but it must have differed in shape from that of the Bushman. Further the trochanteric fossa is not nearly so deep as in man, nor is there a well developed trochanteric crest.

The lesser trochanter has been well developed, but has been broken off. It can be restored with confidence. It is situated somewhat less on the inner side of the femur than in man. When the upper end of a human femur is laid flat the lesser trochanter is practically on the line of the inner side. In Plesianthropus this lesser trochanter is rather nearer the middle of the back of the femur than the inner side. Presumably this means that the femur in Plesianthropus was a little differently orientated. In man the line from the middle of the head to the middle of the great trochanter is directed, when standing, outwards and a little backwards, but in Plesianthropus it seems probable that this line was directed considerably more backwards. This would be in keeping with the structure of the pelvis where the acetabulum looks mainly outwards instead, of outwards and a little forwards as in man.

Below the lesser trochanter there is a distinct ridge as shown in the figure. This is apparently the spiral line. The surface of the bone is not well enough preserved to show whether there is a gluteal tuberosity.

The femur as preserved measures 215 mm. and it seems probable that the total length was about 310 mm. The Bushman femur whose head we here figure measures 322 mm. So that in size it does not differ much from that of the smaller races of man.

Most probably the pelvis and femur are those of a female, while the humerus we have described is certainly that of a large male.

A FEW COMPARISONS.

IN 1904, DUCKWORTH PUBLISHED a series of drawings of median sections of human and other primate skulls showing how they differ and agree. But while he gives many measurements of corresponding arcs and chords, he has only the very briefest discussion of what the differences mean. We are inclined to think that such comparisons do not help us very greatly in determining relationships, and in solving the affinity of mankind. We see much resemblance in the sections of various types of mankind, and some interesting differences. We also see some interesting agreements and differences when we compare the human skulls with those of anthropoids and various Old World Monkeys. But the resemblance are often misleading and we do not know what value to place on the differences. Duckworth gives sections of the skulls of a Macacus and a Cercopithecus which agree rather closely, and a section of a Baboon skull which differs very markedly at least in the face. Yet we know that these three forms are all closely allied. Had he given a section of a Gibbon skull it would have been seen to be strikingly similar to that of Macacus — far more like it than is the Baboon skull; yet the Gibbon is considered by all anatomists to be an anthropoid ape, though a number, including Keith, have shown that it has many close affinities with the Old World Monkeys.

We here give a similar series of sections of skulls (fig. 24). We give a section of the primitive type of man, Cyphanthropus. For comparison we give median sections of two female individuals of Plesianthropus. While these have very much smaller brains than the large presumably male Cyphanthropus, and are much more prognathous, they show considerable resemblance.

The child Australopithecus is probably not unlike what the young Plesianthropus would be.

Figure E, shows a median section of a male Chimpanzee. Here the structure of the brow is seen to differ considerably from that in Plesianthropus, and the skull is more prognathous; but the most important difference is that the occipital ridge is situated as in all anthropoids much higher than in Plesianthropus. If the backs of the skulls of the Chimpanzee, Plesianthropus and Cyphanthropus be compared, the condition in Plesianthropus is seen to be about intermediate between the other two. In the second Plesianthropus skull (fig. D) though the brain is relatively small the occiput is seen to be less like that of the Chimpanzee. But this skull is probably considerably crushed and distorted at the back. We figure it as it is preserved.

In fig. F, we have a median section of an Orang. Here the brow region is rather more like that of Plesianthropus than is that of the Chimpanzee; but the foramen magnum looks a little more backwards than in the Chimpanzee.

Figure G, represents a section of the skull of a Gibbon. Though of course there is some resemblance to the sections of the larger anthropoids the agreement is not very striking, and if this section be compared with those given by Duckworth of Macacus and Cercopithecus it will be seen that the agreement is so close as to suggest that the Gibbon

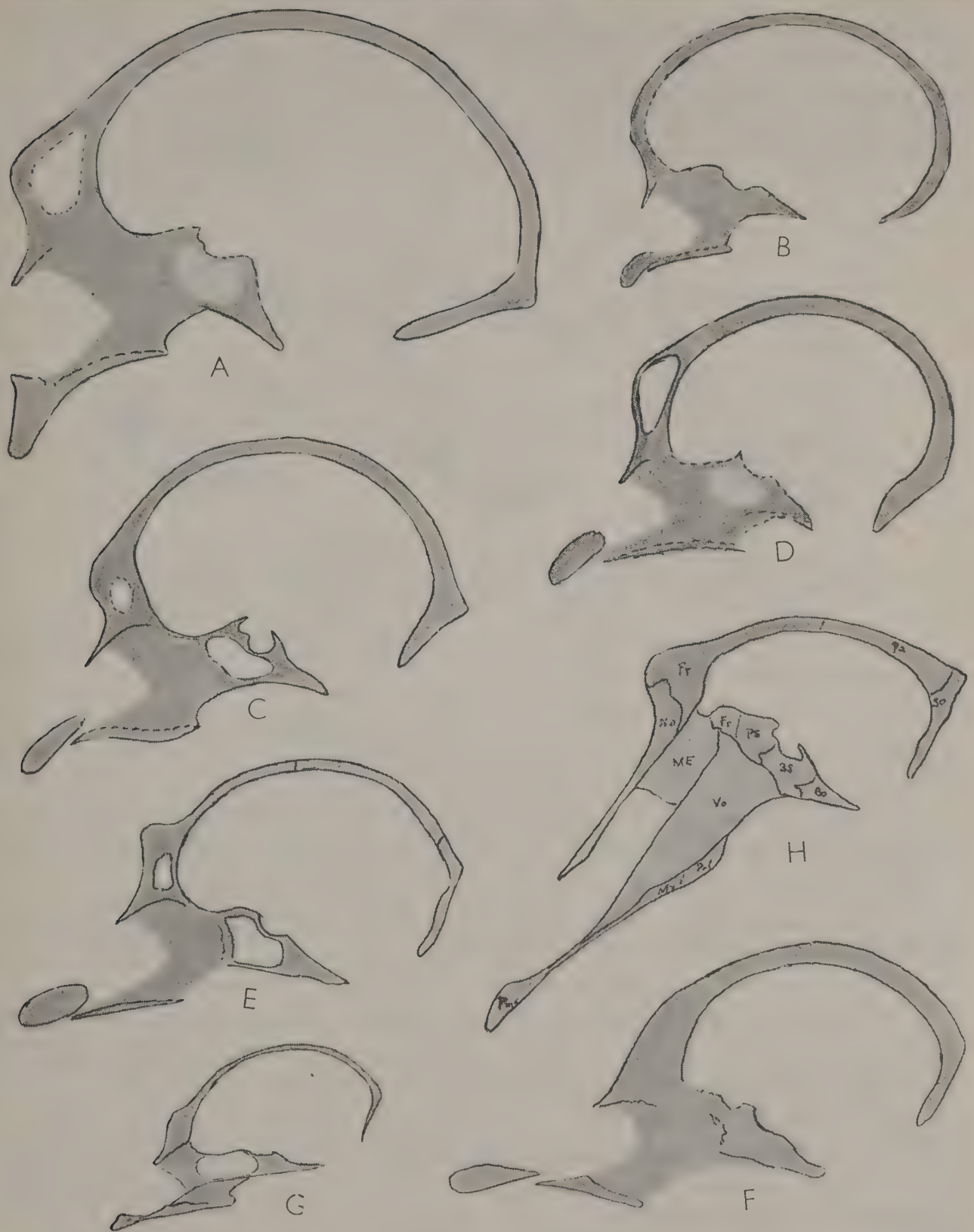

FIG. 24.— Median sections of the skulls of higher Primates. All figures two-fifths natural size. A. *Cyphanthropus rhodesiensis* (Woodward); B. *Australopithecus africanus* Dart; C. *Plesianthropus transvaalensis* (Broom). Skull 5. D. *Plesianthropus transvaalensis* (Broom). Skull 7. E. *Pan* sp. F. *Pongo*. sp. after Duckworth; G. *Hylobates* sp. H. *Papio ursinus* Ker. Large male. B.o. Basioccipital; B.S. Basisphenoid; Fr. Frontal; M.E. Mesethmoid; Mx. Maxilla; Na. Nasal; Pa. Parietal; Pal. Palatine; Pmx. Premaxilla; S.o. Supraoccipital; Vo. Vomer.

is not very closely allied to the higher anthropoids. Its teeth are mainly anthropoid, but one feels inclined to consider it as possible that the Gibbon line branched off from the early anthropoid stem perhaps in the Upper Eocene or Lower Oligocene, and that while it has a few anthropoid characters these may have been the result of a parallel development, and that its main affinities are with the generalised Cercopithecids.

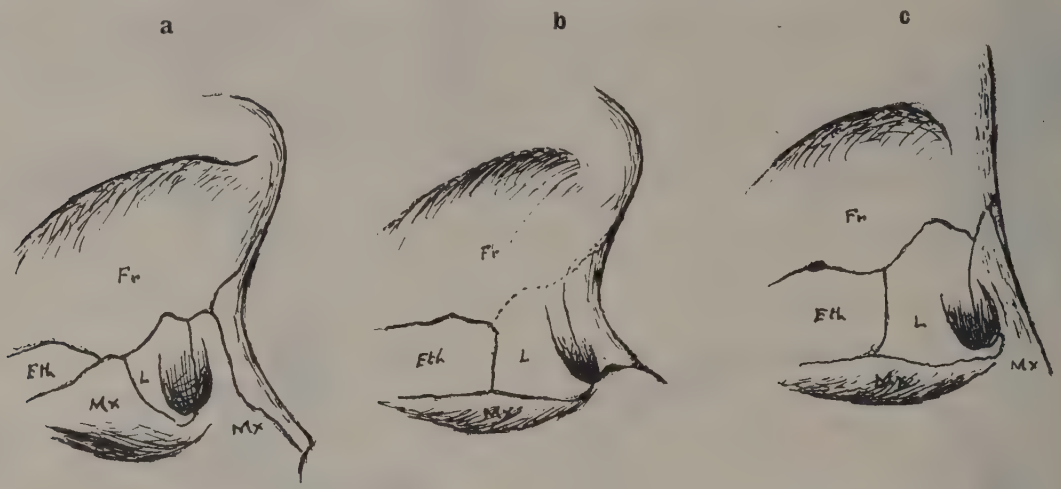

FIG. 25.—Semidiagrammatic views of the inner wall of the right orbit in various Primates. A. Chimpanzee. B. Plesianthropus. C. Bushman. All natural size. Eth. Ethmoid; Fr. Frontal; L. Lacrimal; Mx. Maxilla.

Figure H, is a median section of a large male Baboon. It shows how variable Primates are in their facial development.

It is to be regretted that we have no satisfactory skulls of either the lower Miocene Proconsul or its allies or of any of the Siwalik anthropoids, or of the primitive Propliopithecus. The known skull of Proconsul has no base or occiput.

While the shape of the skull and the development of the brain are unquestionably important characters, we consider that the structure of the teeth of the deciduous and permanent sets are far safer guides for the determination of affinities.

The arrangement of the bones on the walls of the orbit is interesting (fig. 25 and 26). In Plesianthropus skull 5, we have satisfactorily shown the arrangement of the bones on the inner wall, and in skull 8, we see the arrangement on the outer wall.

In man it is well known that the anterior part of the inner wall of the orbit is largely formed by the lacrimal, which articulates in front with the ascending process of the maxilla and also articulates with the maxilla below. Posteriorly it has a large articulation with the front of the ethmoid.

When we examine the orbit of Plesianthropus we find it is almost exactly as in man. The only difference of any importance seems to be that in Plesianthropus the lacrimal canal is much smaller.

In the Chimpanzee the arrangement of the bones seems to be variable. In many skulls — perhaps most — the maxilla passes upwards on the inner wall and meets the frontal shutting off the ethmoid from the lacrimal. In the specimen we figure, the lacrimal canal is much wider than in Plesianthropus, and resembles more the condition in man.

In the Gorilla the condition is generally like that in the Chimpanzee.

In the Orang, on the other hand, the ethmoid has a large articulation with the lacrimal as in man and Plesianthropus; and this is also the condition in the Gibbon.

In all the cercopithecids we have been able to examine there is a large ethmoid plate which articulates with the lacrimal though the frontal generally forms a larger part of the orbital inner wall.

FIG. 26.— Inner view of outer wall of left orbit in various Primates. A. Australian native. B. *Plesianthropus transvaalensis*. C. Chimpanzee, *Pan* sp. D. Male baboon *Papio ursinus* Ker. All natural size. A.S. Alisphenoid; Fr. Frontal; Ju. Jugal; Mx. Maxilla.

Clearly man and Plesianthropus have retained the ancestral condition, as have also the Gibbon and Orang; while the Chimpanzee and the Gorilla have become specialised.

The arrangement of the bones of the outer orbital wall as seen from the inner side is also interesting.

In man there is considerable variation. We give a view of the bones in an Australian skull. Here three bones form most of the wall — the frontal above and the alisphenoid and jugal below. But in front of the spheno-maxillary fissure the maxillary bone comes round and articulates with the front of the alisphenoid.

We do not know in what proportion of human skulls this occurs; but Duckworth has shown that in Australian natives it is quite common — occurring " in ten cases on both sides, in one case on the right only, absent from seventeen cases." We find it in many Bantu skulls, though less frequently than it appears to occur in Australians, and it also occurs in Bush skulls. Duckworth found the spheno-maxillary suture cutting off the malar bone from the fossa in only one Gorilla skull out of over a hundred.

In Plesianthropus (skull 8) the maxilla meets the alisphenoid just as in this Australian skull. But a similar arrangement occurs in Plesianthropus (skull 5) and also in skull No. 6. It is interesting to note that in the only three skulls of Plesianthropus in which this region can be examined the maxilla meets the alisphenoid round the front of the spheno-maxillary fissure, and that, while a similar arrangement is met with in 10 out of 28 Australian skulls, it only occurs once in a hundred Gorilla skulls. In Old World Monkeys the condition is quite common, especially in the smaller sort. We have two skulls of Colobus, and it occurs in one of them. Probably it is the condition in the ancestral Old World Monkey, and while many of the smaller Catarrhines still retain it, it has become lost in most of the anthropoids, but still retained in a considerable proportion of men.

The relation of the tympanic bone to the squamosal in front and especially to the postglenoid process is of interest, and seems to be of considerable importance as an indication of affinity.

In all the Old World Monkeys, so far as we know, the postglenoid process is moderately developed, and the tympanic bone which forms a tube for the auditory canal opens in most cases very considerably above the level of the postglenoid process. Dr. Allen of the American Museum has published photographs of 25 skulls of Colobus, taken by Dr. Herbert Lang, and in only four of these has the external auditory meatus its lower border about as low as the tip of the postglenoid process. All the others are much above the process. In Baboons the auditory meatus is always high up, and much behind the postglenoid process, and so it is in Cercopithecus. Among the anthropoids we find that the Gibbon agrees closely with the Cercopithecids. We give a figure of the condition in a large male Orang (fig. 27A). Here we see a very large postglenoid process, and the external auditory meatus relatively small and situated well above it. In this figure the mastoid region is very large, and its lower end is situated in the same plane as the occipital condyle.

In fig. 27B, we give a similar view of a large male Gorilla. Here the postglenoid process is also very well developed, and the tympanic bone bears almost the same relations to it as in the Orang. But the tympanic is greatly developed and thickened at the meatus. Here the mastoid region hides the occipital condyle.

In fig. 27C, we have a drawing of the condition in a very large male Chimpanzee. The postglenoid process is considerably shorter than those in the Orang and Gorilla figured, and the tympanic bone is situated lower, so that the lower border of the meatus is nearly on a level with the tip of the process. The occipital condyle is seen behind the lower part of the mastoid.

In fig. 27D, we have the same region in a female Chimpanzee. Here the parts are essentially similar to those in the male figured, but the process is rather smaller and the tympanic meatus distinctly smaller. The occipital condyle is seen below the lower part of the mastoid.

In fig. 27E, is shown a true side view of the ear region and the glenoid in *Plesianthropus transvaalensis* as seen in skull 5. Here the postglenoid process is apparently double. The front portion is the true process; but immediately behind it is a sort of reduplication, and behind this we see the auditory meatus of the tympanic bone. This is a large round ring which forms a little more than a semicircle, and the centre of the completed circle would be on the same level as the tip of the postglenoid process. The

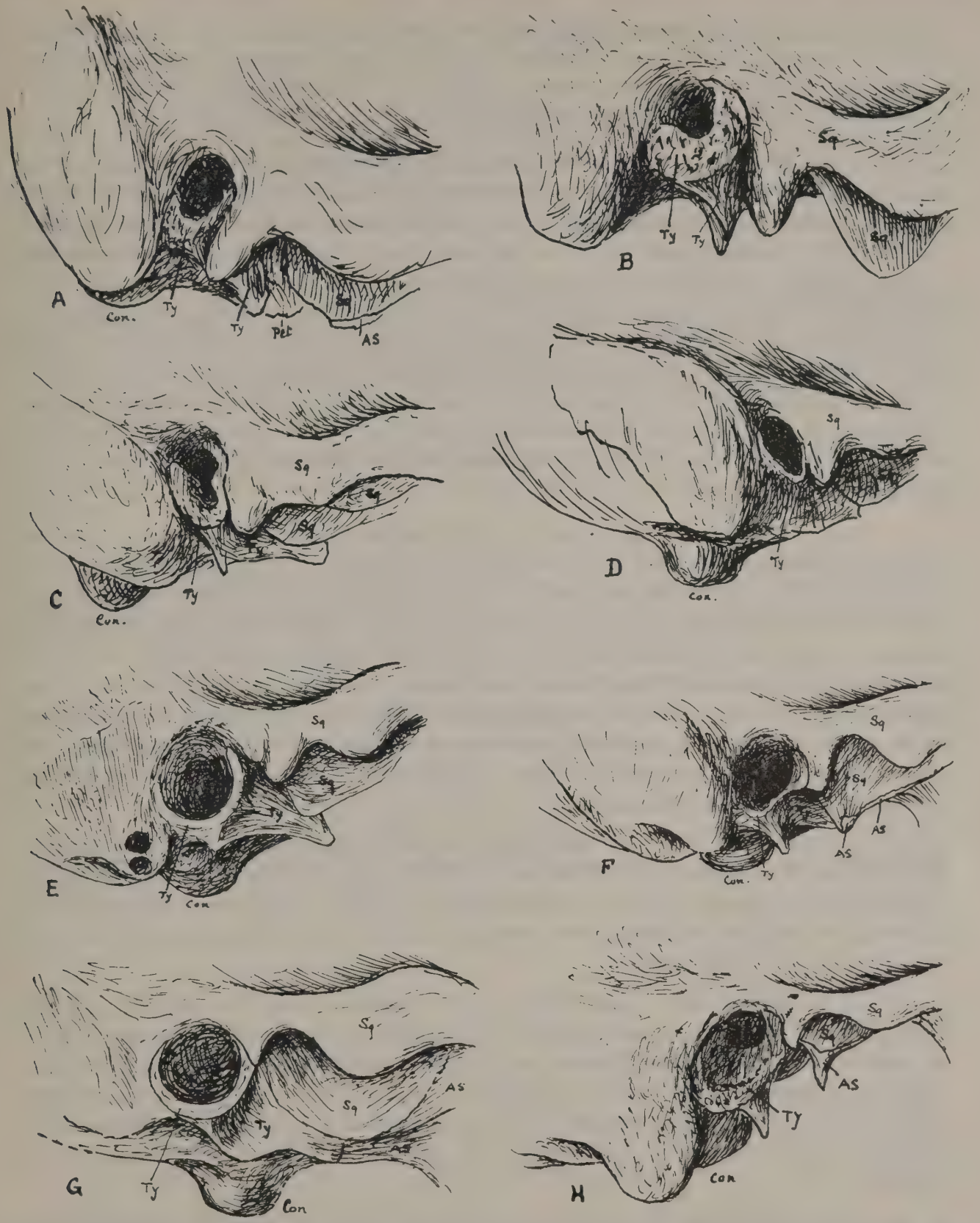

FIG. 27.—Tympanic region in various higher Primates. A. Large male Orang; B. Large male Gorilla; C. Very large male Chimpanzee; D. Female Chimpanzee; E. Female Plesianthropus (Skull 5); F. Female Plesianthropus (Skull 8). (Left side reversed); G. Probably male Paranthropus (left side reversed); H. Large probably male Korana. All figures natural size. A.S. Alisphenoid; Con. Occipital condyle (in B. it is hidden by the mastoid development); Sq. squamosal; Ty. Tympanic.

condition will be seen to be very different from that seen in any of the anthropoids we have at hand, or have figures of. Behind and below the tympanic are seen two large mastoid cells that have been accidentally opened. The occipital condyle will be seen well in front of the mastoid process and immediately below the auditory meatus.

In fig. 27F, we have the same region in Plesianthropus, as shown in skull 8. Here the structure differs considerably from that shown in fig. 27E. The postglenoid process is a little more developed in skull 8, and there is no thickening or reduplication of the bone behind it. The tympanic bone is thinner here and the front of it is attached to the glenoid process, and the lower part of the meatus is well below the level of the process. The occipital condyle is a little behind the plane of the auditory meatus, and a little in front of that of the mastoid process. It is interesting to note the differences in this region in skulls 5 and 8. The skulls were found only about 10 yards apart, and there can be no reasonable doubt that both belong to the same species. Clearly there is a very considerable degree of variation in *Plesianthropus transvaalensis*. In skull 7, the condition of the ear region resembles essentially that of skull 8, but there are other striking differences in the skulls partly due to crushing.

In fig. 27G, we have the structure of the glenoid and auditory regions shown as seen in *Paranthropus robustus*. Here the postglenoid process is relatively small, and the outer end of the tympanic forms much of a large ring the front part of which is articulated with the back of the small glenoid process, making with it a continuous wall to the back of the outer part of the glenoid cavity. This differs appreciably from the condition in either of the specimens of Plesianthropus, and agrees essentially with the human condition. Except for the fact that the parts are rather larger the structure of the outer part of the tympanic and the postglenoid process can be closely matched in human skulls. The mastoid region is relatively small and the occipital condyle is seen to be here very slightly in front of the plane of the meatus.

If these three figures of the glenoid region in Australopithecids are compared with the four of anthropoids it will be seen that all three are characterised by having the auditory meatus placed much lower, by having the occipital condyle further forward, and in having the articular eminence better developed. In all these three characters the Australopithecids agree with man.

In fig. 27H, we have a view of the auditory region in man. The example given is from a Korana skull. But it matters little which skull we take, as all human races appear to agree fairly closely. In this Korana skull the postglenoid process is small, and the outer end of the tympanic fairly large. It articulates with the process as in the Paranthropus skull, and the Plesianthropus skull 8. The mastoid process is very well developed and the occipital condyle situated as in Plesianthropus skull 8, a little behind the plane of the meatus.

We might deal at some length with the structure of the mandible of Plesianthropus and make some detailed comparisons with the jaws of Old World Monkeys anthropoids and man. But we have only one fairly satisfactory specimen, and we do not know how variable the jaw may be, and this specimen has its inner side hidden so that we cannot be sure of the structure of the whole of the back of the symphysis, and we cannot at

present see the structure of the middle of the ascending ramus. And also very few quite satisfactory fossil anthropoid jaws are known.

We can, however, say that this jaw resembles much more closely human jaws than those of any of the living anthropoids. The symphysis is very unlike those of the Chimpanzee or Gorilla, but has some resemblance to that of Proconsul. But in other respects the jaw differs considerably from that of either Proconsul or its allies Xenopithecus or Limnopithecus. The way in which the teeth are worn is not unlike that of man, and quite different from that of the anthropoids.

We have already shown that the deciduous molars of Plesianthropus are practically human in structure and so unlike those of any known anthropoids that we do not think that it can have any close affinity with the higher anthropoids, and we think it more closely allied to Man. The permanent dentition we have shown is also almost typically human in structure.

The remains we have of humeri and femora seem to be more man-like than ape-like. The scapular fragment is too imperfect to justify us making any detailed comparisons.

The pelvis certainly resembles more that of man than that of any known anthropoid. In fact it is so very unlike that of any of the living anthropoids that we think it unlikely that any anatomist will longer support the view that Australopithecus and the allied Plesianthropus are only Chimpanzees or dwarf Gorillas.

A very eminent anatomist has recently said: "It can be asserted with every possible assurance that all of them [Australopithecus, Plesianthropus and Paranthropus] are apes, and that they throw no light whatever on the primate forms that were ancestral to *Homo*." Even this opinion we are sanguine enough to think may be modified when the pelvis is studied. Another and equally eminent anatomist recently wrote — even before the pelvis was known — "It is difficult to disagree with Broom's conclusion that 'Man arose from a Pliocene member of the Australopithecines, probably very near to *Australopithecus* itself."

NATURE AND AGE OF THE DEPOSIT.

THE STERKFONTEIN CAVE with its many deposits is situated about six miles north-west of Krugersdorp in the Transvaal. The large cave has been known for over 50 years. Though it is usually referred to as the Sterkfontein Cave, it is really situated on the adjoining farm Swartkrans.

The earliest reference to the caves in this region seems to be in a report made by the eminent geologist, Mr. David Draper, who in 1895, reported that "he had a short time ago visited the Kromdraai Caves or rather the foundering of what had once been caves, and he had found them most interesting from a geological point of view. There was much to be discovered there."

But a much more important reference was made by Mr. M. E. Frames at a meeting of the South African Geological Society on 13th September, 1897. In speaking of the "animal remains found in the Kromdraai Caves in the Dolomite near Krugersdorp" he says:— "Amongst these are those of the horse species, antelopes, monkeys, porcupines, rats, bats, etc., and the presence of the first two in the cave would lead us to infer that they had been dragged there by beasts of prey. The cave is now filled with bones, cave earth, and stalagmites to a depth of about 15 feet, and the whole mass is consolidated into hard rock. The latter feature naturally points to the antiquity of the cave and its contents."

One would think that the scientific world might have considered such caves worthy of further study; but for about forty years no scientist even appears to have visited them, so far as we know. And during all these years tons upon tons of this wonderful bone breccia were being burnt for lime in lime kilns. And we can now be pretty sure that there must have been many dozens of skulls and skeletons of higher primates, and possibly of pre-men destroyed.

After the discovery of the Plesianthropus skull in 1936, the cave became more famous; and in 1938, Mr. H. B. S. Cooke, of the Geological Department in the Witwatersrand University, examined the cave, and wrote a short paper on it, which was published in "The South African Journal of Science", Dec., 1938. He gives a plan and section of the upper part of the cave, and discusses the nature of the bone breccia. As, however, in a more recently published paper (1948), he states that his "earlier preliminary conclusions were in error in several respects," and as he has not stated which views he has changed, and which he still holds, it is impossible to criticise the paper.

On 22nd July, 1947, Dr. S. H. Haughton read a paper at a meeting of the Geological Society of South Africa, entitled, "Notes on the Australopithecine — bearing Rocks of the Union of South Africa"; and this paper was published early in 1948. He says: "Whether the bones present are those of animals that died in the caves or were transported there after death together with sand and limestone fragments is an unsettled question."

Haughton suggests that the new classification of the Pleistocene, proposed at Nairobi in 1947, should be accepted in South Africa; but he adds — " At present to assign the Taungs and Krugersdorp deposits to one or other of these time units is impossible. Further information concerning them and concerning deposits in the vast area which lies between them and Tanganyika Territory is essential before valid reasons can be given for such assignment; but the problem of correlation is not impossible."

But though Haughton says that to assign " time units " to any of the deposits is impossible, he has no hesitation in stating that the Taungs and Krugersdorp area fossils " are contemporaneous." As the faunas in the caves at Taungs, Sterkfontein and Kromdraai are almost entirely different, we think it unlikely that any zoologist will agree to their being even approximately contemporaneous.

All the known specimens of Plesianthropus have come from an open quarry on the top of the hill at Sterkfontein, and from workings in what are probably parts of the same deposit at about 30 feet lower level. Much of the hill is riddled with caves, and some of the caves in the upper levels have been refilled with stalagmitic deposits and bone breccia. In our opinion the bone breccia is mainly dust and sand in which lie numerous broken bones, and the whole cemented by lime infiltration. The bones of larger animals have we believe all been introduced by large carnivores, apparently sabre-toothed tigers; and most of the small bones such as those of rats, moles, birds, etc., where they occur, are we believe from the remains of disgorged pellets of owls.

Nearly all the larger bones are broken, often into quite small fragments. Complete bones are rare. Skull No. 5 was quite an isolated specimen in the midst of brown cemented blown dust with few other bones, but with a few broken pieces of dolomite. There were no other bones of this specimen of Plesianthropus; and though the skull was nearly perfect there are indications that it had in three places been gnawed, by presumably a rodent. Skulls VI and VII were from places in the deposit about 12 to 20 feet from skull No. V. Here the deposit was different. It was mainly broken fragments of dolomite and chert cemented together by brown bone breccia. In each case the skull was practically surrounded by the broken dolomite and chert fragments. Each skull had been presumably half eaten. It is not a case of our having lost half of these skulls. Only about half of each had been in the rock.

Of the associated animals the commonest is a species of the little baboon, *Parapapio broomi*, and the next commonest is a large antelope allied to the Eland. All the bones are broken; and, though the " baboons " are quite common, good skulls are difficult to obtain. We have not so far found one perfect one. And of the large antelope we have not obtained even one good jaw.

There seems to be little doubt that the quarry which has yielded our best Plesianthropus specimens is the upper part of a large cave which for many years had been the lair or lairs of sabre-tooths, and that the bones had been introduced by them. From time to time pieces of dolomite and chert have fallen down from the roof and side walls of the cave, and become mixed with the bones, and all the time the interstices were being filled up by the wind-blown sand and dust, and later all cemented into solid rock by lime.

We are well aware that in Europe, the bones in caves are held by some geologists to have been introduced by floods. Even Huxley, in "Man's Place in Nature" (1863), says:— "the bones of Men and Mammoths, Hyaenas and Rhinoceroses were washed pell-mell into the cave of Engis." We think this is improbable; and are quite confident that at least the bones in the cave on the top of the hill at Sterkfontein were never "washed pell-mell" in by floods.

It is at present impossible to give more than a rough approximate of the age of the cave deposit at Sterkfontein. Within a radius of 3 miles of the main cave at Sterkfontein there are dozens of deposits — probably over a hundred, and they certainly in our opinion differ greatly in their ages. Some are probably fairly recent: some possibly as old as Pliocene. Even deposits that are fairly close together may differ greatly in age. Thus in a large quarry only about 100 yards from the Sterkfontein Cave horses are found, but no horse has been found in the Sterkfontein main cave. Then the Kromdraai main deposit is less than 2 miles away, but all the species found at Kromdraai except one rat are quite different from those at Sterkfontein. The baboons are different; the jackals are different, and so are the hyraces. And of course, the Ape-men are so different that they have to be placed in different sub-families.

At Bolt's workings only a mile and a half away in the other direction there are a large number of deposits, and most of these have quite different faunas from those found at the Sterkfontein main cave.

Within a circle of less than 4 miles diameter we have found four different species of sabre-toothed tigers belonging to certainly two — possibly three — different genera. And we know seven different species of baboons.

At Bolt's, there is a fossil golden mole, but it belongs to a different genus from the fossil golden mole found in the Sterkfontein cave. Horses are abundant in some deposits at Bolt's, and at Kromdraai, but have so far not been found at Sterkfontein main cave.

We can give lists of the animals in a number of the deposits, but they do not help us greatly in determining the age. The majority of the animals are African forms which do not occur in Europe, Asia or America. And even the few genera that are known in the Northern Hemisphere do not give us much help. A jackal of South Africa does not differ very greatly from some of those of Asia, and our "baboons" are not very far removed from some forms still living even in Celebes. The dassies or hyraces are unknown in Europe, India or China. We have at least four different hyaenas; but hyaenas are known by a large number of species in India, and also in Europe. And they help us very little in determining age. A form which Broom placed in Lycyaena occurs in the Sterkfontein cave, and so far has been found in no other.

All we can do at present is to go on collecting in the hope that some form will turn up that may throw more light on the problem. But there are no great hopes that it will be solved in the next 20 years. Even if we found a form comparable to one known in India or Europe it might lead us to quite a wrong conclusion. The peculiarly specialised Elephant Dinotherium was for many years known in different parts of Europe and India in beds which ranged from Lower Miocene to Middle Pliocene. Then a Dinotherium

was discovered at Oldoway in Tanganyika in 1935, in beds which we know to be Middle Pleistocene, and also at Kanam where it is associated with *Homo kanamensis*. We thus see that a genus that is characteristic of European Miocene and Lower and Middle Pliocene may survive in Central Africa to the Middle Pleistocene. So our difficulties will be readily appreciated.

As not a single one of the 14 species that are known to occur at Taungs is known in the Sterkfontein deposit, we think it likely that the majority of scientists will agree with us in considering that the deposits are of very different ages, notwithstanding the opinion of Haughton and Cooke that they are contemporaneous.

In the book on " The South African Fossil Ape-Men ", Broom has given his reasons for considering that the Taungs deposit may be Upper Pliocene or possibly Middle Pliocene, the Sterkfontein deposit probably Upper Pliocene, but much later than the Taungs deposit, and the Kromdraai deposit Lower Pleistocene. We know of no reasons for differing from this probable estimate made a couple of years ago.

CONCLUSIONS.

WE HAVE GIVEN DESCRIPTIONS of all the more important remains of Plesianthropus that have been found recently. These comprise a considerable number of skulls one of them perfect, a fine mandible, most of the dentition that was not previously satisfactorily known, including much of the upper deciduous dentition and the complete lower milk dentition. We have described portions of the scapula and humerus, and the complete os innominatum. We thus know Plesianthropus better than any other fossil primate except Mesopithecus, and some Lemurs — better even than the well known Sinanthropus, and we have to discuss its affinities.

We have elsewhere already given our opinion that the Australopithecidae are higher primates closely allied to man, and members of the family that probably gave rise to man, and though, being more primitive than man as we know him, retaining a few early characters that have suggested that they might be allied to anthropoids such as the Chimpanzee, not nearly related to any known anthropoids living or fossil except perhaps the Lower Oligocene Propliopithecus.

Le Gros Clark of Oxford, who, in 1946, visited South Africa, and examined all the finds that had been made up till then, has been fully convinced that our fossil ape-men are more nearly related to man than to the anthropoid apes.

Though Sir Arthur Keith, for some years after the discovery of Australopithecus by Dart, continued to support the view that it is an anthropoid that had by parallel development acquired a number of man-like characters, he modified his views very considerably after the discovery of the adult Plesianthropus and Paranthropus skulls and skeletal remains.

Gregory and Hellman visited South Africa in 1938, and examined all our specimens then available. They more especially made an intensive study of the teeth, and they too were convinced that our ape-men are much nearer to man than any other forms previously known. Hellman died a few years ago, but Gregory fortunately is still with us. I believe he still holds that the Australopithecidae are nearly allied to man; but he considers that both man and the Australopithecids have descended from a Dryopithecus-like anthropoid of the Upper Miocene.

Arambourg of Paris accepts the view that man branched off very early from the anthropoid stem, and that the South African fossil forms represent a family from one of which man as we know him may have arisen.

There are a number who agree with Gregory that the Australopithecids are anthropoids allied to the Chimpanzee or some earlier forms such as the Dryopithecids.

Wood-Jones holds that man has no close relationship with the anthropoids; but has evolved by quite a different line which came from a pre-anthropoid — perhaps a

pre-catarrhine Monkey somewhat allied to Tarsius, but without the specialisations. Australopithecus and its allies he regards we believe as anthropoid apes not at all nearly related to man.

Wood-Jones further considers that man can have no near affinity with the apes because man has no premaxillary-maxillary suture, while the anthropoid apes and the Catarrhines have. But Weidenreich has just pointed out that in a specimen of an infantile pygmy Chimpanzee in the American Museum there is not the slightest trace of the suture on the face. " This proves," he adds, " that typical human features may appear in primates whose general simian character cannot be denied."

In the only known specimen of Australopithecus there seems to be a suture between the premaxilla and the maxilla near the border of the nostril on the left side, but we cannot find one on the right side. This suture on the left side (if it is a suture) is well shown in the photograph of the face of Australopithecus in Plate II in " The South African Fossil Ape-Men." If this suture is of fundamental importance in deciding whether a fossil primate is human or anthropoid then Australopithecus is an anthropoid on the left side and a human being on the right.

The suture, as shown by Ashley-Montagu, seems to be a variable character. No doubt in man the maxillary bone grows into and becomes fused very early with the premaxillary rudiment, and this appears to be the result of the crushing forward of the canine germ by the other teeth, while the muzzle has become shortened.

In all the Catarrhines and in the anthropoids the skulls are developed on very similar lines to those in man. Small skulls have never massive supraorbital ridges: large skulls in quite different groups often have; e.g. Mandrill, Gorilla, Rhodesian Man, Steinheim Man, Neanderthal Man. The Gibbons according to their teeth are anthropoids, but in many other characters are nearer to the Old World Monkeys.

Different criteria have been used to classify the Primates, and our final views must be decided by which are the most important. The structure of the skeleton is doubtless of much importance, and the muscular anatomy gives us many interesting clues. Much importance has been placed on the early development of the placenta, and the relation of the ovum and its membranes to the uterus. Other important facts are revealed by the study of the early development of the skull. The study of the visceral anatomy also gives us some guidance.

Unfortunately none of these criteria is of the slightest value in connection with extinct primates, except in the case of those very few forms where we know the skulls and skeletons. Curiously enough we know quite a number of skulls and skeletons of fossil Lemurs, but so far as we are aware only one Old World Monkey (Mesopithecus) is known by a skull and skeleton, and, though many jaws are known of fossil anthropoids, only a few fragments of skulls and a very few isolated bones have ever been discovered.

We are thus compelled in our study of extinct primates to rely on the dentition as practically our sole guide. Fortunately this guide seems to be more reliable than any other criterion which we may consider in living forms.

If we study the dentition of the large living anthropoids, Gorilla, Chimpanzee and Orang, we are a little surprised to find how closely they agree. Not so very long ago

the Gorilla was placed in the same genus as the Chimpanzee; and the teeth of the Chimpanzee agree remarkably closely with those of the Orang, although it seems probable that the common ancestor lived as far back as the Upper Oligocene.

We know many Indian Pliocene anthropoids from the Siwaliks. Unfortunately we know them only by fragmentary jaws and teeth; but it is surprising to find how closely they agree with both the Chimpanzee and the Orangs in all essentials.

In the Miocene of Europe and Asia we find somewhat earlier anthropoids represented mainly by jaws and teeth, the best known being species of Dryopithecus. And these European early apes so closely agree in their dentition with some fossil forms from India that some of these Indian types have been placed in the genus Dryopithecus.

But, thanks mainly to Dr. Leakey, we now know the anthropoids that lived in Central Africa in Lower Miocene times — perhaps 15,000,000 years ago, even better than the European Dryopithecus or the Siwalik apes. Originally described by Hopwood, under the generic names Proconsul, Xenopithecus and Limnopithecus, and in 1933 only known by fragmentary jaws and teeth, we now know them by a complete mandible, much of some snouts, most of the dentition, and a number of portions of the skeletons.

The teeth of these very early anthropoids differ very little from those of the living Chimpanzee and Orang. There are a few primitive characters that are lost in Dryopithecus, the Siwalik types and the living large anthropoids, but these Early Miocene anthropoids are so surprisingly similar to living types that we seem hardly justified in placing them in a different family.

All this seems to mean that the anthropoid type of dentition has scarcely changed in 15,000,000 years; and we can feel perfectly confident in stating that Proconsul is fairly closely related to Pan and Pongo. And we can go further back. In the Lower Oligocene of Egypt we have the remains of the little Propliopithecus. Here we find a dentition slightly more primitive than that of the later anthropoid apes, but still essentially anthropoid.

We thus see how unvarying a dental type can remain for millions of years. In man we find a type of dentition a little like that of the anthropoids, but differing in a number of important characters, and the question must be considered whether the human type could have been evolved from the type found in the anthropoid.

Weidenreich has emphasized the peculiar structure of the canines and anterior premolars in the anthropoids. In the males of the anthropoids the upper canine is powerfully developed and forms a cutting apparatus with the front of the first lower premolar, which is flattened and no longer a molariform tooth as it probably was in the ancestral primates. In man we have the upper canines meeting the lower and the premolars of the upper and lower jaws grinding against each other, and the question arises — could the human specialisation have arisen from the type seen in the Chimpanzee? At first sight it seems improbable; but we have to remember that in the female anthropoids the canines are much less developed than in the males, and may even meet the lower canines in almost human fashion. Weidenreich gives a figure of a female Orang teeth (fig. 306) with a nearly edge to edge bite. And if this can be developed in the female anthropoid might the human dentition not have been evolved from an anthropoid type? If we only knew the adult dentition we might consider it as not improbable.

When we study the deciduous dentition, however, we see such differences that we feel compelled to conclude that the anthropoids have specialized from an ancestral type which is still retained by man.

In the Old World Monkeys such as Papio, Cercopithecus and Colobus we find that the 1st lower milk molar is a molariform tooth with four well developed cusps. In the four living anthropoids — Hylobates, Pongo, Pan and Gorilla this 1st lower molar has become practically a sectorial tooth with only one large cusp. Rudiments of some of the ancestral cusps are still seen in the Gibbon, Orang and Chimpanzee, but they are only rudiments. As all the living anthropoids show this same specialisation we can be very safe in assuming that it is very old — probably dating back to the very base of the Oligocene.

In man we have scarcely a trace of this specialisation. We have a molariform tooth with four main cusps which are well developed. Sometimes we have a posterior fifth cusp and even a small anterior sixth cusp. As the tooth is thus fundamentally of the same type as is found in the Old World Monkeys we are probably right in assuming that the human line has been evolved from either an Old World Ape or from a very early type of anthropoid which had not yet evolved the specialised cutting premolar.

Doubtless the human molars agree more closely with those of the anthropoids than they do with those of the Baboon or Colobus; and it is thus more likely that the human ancestor was an early anthropoid. But this type of molar is very old. We find it already in Propliopithecus of the Lower Oligocene. We even find it in Parapithecus which is hardly yet an anthropoid.

In the Lower Miocene apes of Central Africa we have types which, in most characters at least of their dentition, resemble the Chimpanzee and the Gorilla, but they have retained a few earlier characters. A number of canines are known which retain a rudimentary posterior cusp. This is lost in all the living anthropoids, but is met with in numerous Monkeys of both the New and Old World. It is evidently an early character.

The lower milk teeth of Limnopithecus were described and figured by Hopwood. The published figures are not very satisfactory, and Hopwood has kindly sent us a cast of these teeth.

At first sight the anterior milk molar looks like a molariform tooth, and on the strength of this Arambourg has placed Limnopithecus on the human line. But the examination of the cast leads us to think that the tooth is really a bicuspid tooth with a large outer anterior cusp and a small antero-internal cusp and with the posterior cusps scarcely developed. The tooth is thus not unlike that of the Orang, but more primitive, and not like the milk premolar of man where the posterior cusps are well developed.

Of course we do not know all the possibilities of evolution. We know that the second and third premolars in Eohippus are cutting teeth, but in all Oligocene horses these have become molariform; and it might be argued that if the molariform premolars of the later horses have been evolved from non-molariform premolars of the Eocene horse why could not the human bicuspid first lower premolar have been derived from the unicuspid premolar of the Chimpanzee? The cases are not quite parallel.

In the horse a cutting premolar became a molariform tooth; but in the line of Primate evolution we would have to assume that a cutting premolar gave rise to a molariform tooth in the Old World Monkeys. Then the molariform premolar of the cercopithecids gave rise to the cutting premolar of the anthropoids and last of all the cutting premolar of the anthropoids gave rise to the bicuspid teeth of man. We know of no such case in any other line of evolution; and think it most unlikely to have happened in the human line.

Then the milk dentition of man seems clearly to have evolved from that of a pre-anthropoid type; and it seems more likely that the adult dentition is also derived from an early or pre-anthropoid type than from a dentition such as we find in the living anthropoids.

The anterior lower milk molar of Paranthropus is a five cusped tooth with a well marked anterior fovea. It is in pattern practically identical with some human adult lower molars. There is no sign of any specialisation or degeneration. It seems to us most improbable that such a tooth could have been evolved from such a tooth as is found in the Chimpanzee, the Orang, the Gibbon, or even Limnopithecus.

All the evidence from the dentition is in our opinion in favour of man having been derived from a pre-anthropoid, and we think it fatal to any theory that would favour the descent of man from at least any specialised anthropoid.

The Australopithecids agree with man in most details of their dentition, and if the argument, that man must have come from a pre-anthropoid, be sound, it would apply equally to the Australopithecids. They seem to be but early small brained primates, that are nearly man.

Weidenreich's position is not quite clear. In 1943, he wrote: "The hominids must have branched off from the common stem of the anthropoid stock before *Dryopithecus* and other fossil members of this group developed. The stem was thus divided into two branches, one with a more homomorphic canine group leading to and represented by the hominids, the other with a heteromorphic canine group leading to *Dryopithecus,* its relatives and descendants, that is to say, to the anthropoids in the strict sense of the term." He also says: "*Australopithecus* [Plesianthropus] apparently belongs to the same anthropoid main branch as the hominids characterised by the greater homogeneity of the canine group."

With both of these statements we fully agree. But in a recent paper in the "Robert Broom Commemorative Volume" (R.S.S.Af., 1948), he expresses some doubts. He says: "One point is certain: the known Australopithecinae differ from anthropoids both living and fossil, by the character of their dentition.

The form and pattern of the molars, the canines and the lower first premolars resemble those of primitive hominids as represented by Pithecanthropus and Sinanthropus and are dissimilar to those of anthropoids to the same extent." But he goes on to argue that because Australopithecus is supposed to have a certain peculiarity in the brain it must still be an ape. He says: "One of the most characteristic peculiarities wherein the anthropoids differ from hominids is the way in which the lateral contour of the frontal lobe . . . . meets that of the temporal lobe at the place where the sylvian fissure runs

upwards and backwards. In Gorilla and Chimpanzee the contour of the frontal lobe continues the upward and forward direction of the temporal lobe while in early hominids, even if the brain is as small as that of Pithecanthropus, there is a distinct indentation and change in the direction of the outline. This marks a difference in the character of the sylvian fissure." Further he says: " the Australopithecinae are apes as far as their general morphological character is concerned, but show in addition certain features which are found in man."

This conclusion seems to place Weidenreich in an awkward position. Man must have come from a very early or pre-anthropoid because of his peculiar dental structure; but the Australopithecidae, which have exactly the same dental structure as in man, must be apes.

Weidenreich points out that in the Chimpanzee and Gorilla the temporal lobe runs up to the frontal without any marked indentation at the sylvian fissure. This is undoubtedly the case; and he points out that in even Pithecanthropus there is a very clear indentation as in man.

He refers to the " uncertainty of a comparison based on casts." and the difficulty which has arisen is due to his having relied on a cast or casts which apparently have been unsatisfactory. Schepers has restored both Australopithecus and Plesianthropus brains with a very distinct indentation at the sylvian fissure.

Weidenreich gives three figures which are very interesting. One is a copy of Schepers' restoration of the Australopithecus brain with a Chimpanzee brain of similar size plotted against it. The second is the Australopithecus brain with a Gorilla brain for comparison; and the third a comparison of the Pithecanthropus brain reduced to the same size as that of Australopithecus.

If Schepers' outlines are correct, and they seem to be correct, we see the marked differences in the first two figures of the sylvian indentation seen in Australopithecus, but not in the Chimpanzee or Gorilla; and the even more remarkable differences in the arrangement of the lateral sinus. In Australopithecus the anterior and lower end is further forward as it has to be from the forward position of the foramen magnum.

In the third figure the general agreement is so marked that the Australopithecus brain might be said to be only a small Pithecanthropus brain. The sylvian indentation is fairly similar in the two, and the position of the lateral sinus is almost identical.

Presumably Weidenreich considers that Schepers is in error in considering that the " frontal and temporal lobes are sharply separated." The only known specimen of Australopithecus is Dart's original type skull; and just about this region the skull is broken across.

In the specimen the sylvian fissure is still partly filled with bone, and it is quite manifest that there is a ridge of bone dividing the temporal and the frontal lobes exactly as in man.

In the type Plesianthropus brain there might be more room to doubt the condition, as just in this sylvian region the brain case has been appreciably crushed down; and in the Paranthropus skull there is practically no satisfactory evidence of the anatomy of this region.

Luckily the skull we found on 18th April, 1947, shows the whole of this region in perfect condition, and the imperfect skull No. 8 shows it nearly as well. There we see that there is about as deep an indentation in the brain as there is in man. So that this character which Weidenreich regards as an important one in distinguishing man from ape shows that the Plesianthropus condition is certainly as in man, and quite different from the ape condition.

It is interesting to note that we have a skull of Colobus which agrees with man in this feature much more than it does with the anthropoids.

If any doubt remained about the position of the Australopithecidae, the pelvis seems to settle the question. It is nearly human, and hardly at all anthropoid in structure. Of course in being not yet quite human it is but natural to find some primitive characters, and the ischium shows that Plesianthropus is only nearly human.

The child skull of Australopithecus, the adult skull of Paranthropus and the jaw of the young child, and the many skulls and parts of skeletons of Plesianthropus reveal to us a group of Primates that are nearly human, but not quite, and a group that approaches man so closely as to leave little doubt in our opinion that it was from a member of this family the Australopithecidae, or a closely allied form, that man arose.

It seems to us clear that neither man nor the Australopithecids can be at all closely allied to any of the anthropoids at present alive, or to any of the known fossil ones, except Propliopithecus. This early Egyptian form must we think be pretty closely allied to the human and Australopithecid ancestor; but probably the human ancestor was a type just a little more primitive and less specialised along the anthropoid line.

The University of California African Expedition has recently spent some months in the Fayum trying to get further remains of Propliopithecus, but without success. But doubtless other remains will be found ere long, and there are other fields in Africa to be searched. Our caves in the Transvaal are far from being exhausted, and ought to keep us fully employed for many years to come; and the chances of our being able to solve completely the problem of the Origin of Man are very considerable.

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PLATE 1.

FIG. 1. Side view of skull of female *Plesianthropus transvaalensis* (Broom). Skull 5. Two-thirds natural size.

FIG. 2. Front view of skull of female *Plesianthropus transvaalensis* (Broom). Skull 5. Two-thirds natural size.

FIG. 3. Front view of skull of female *Plesianthropus transvaalensis* (Broom). Skull 7. Two-thirds natural size. The parietal region is a little crushed in on right side.

FIG. 4. Palate of female *Plesianthropus transvaalensis* (Broom). Skull 6. Two-thirds natural size.

FIG. 5. Outer view of ear and glenoid cavity of *Plesianthropus transvaalensis* (Broom). Skull 8.

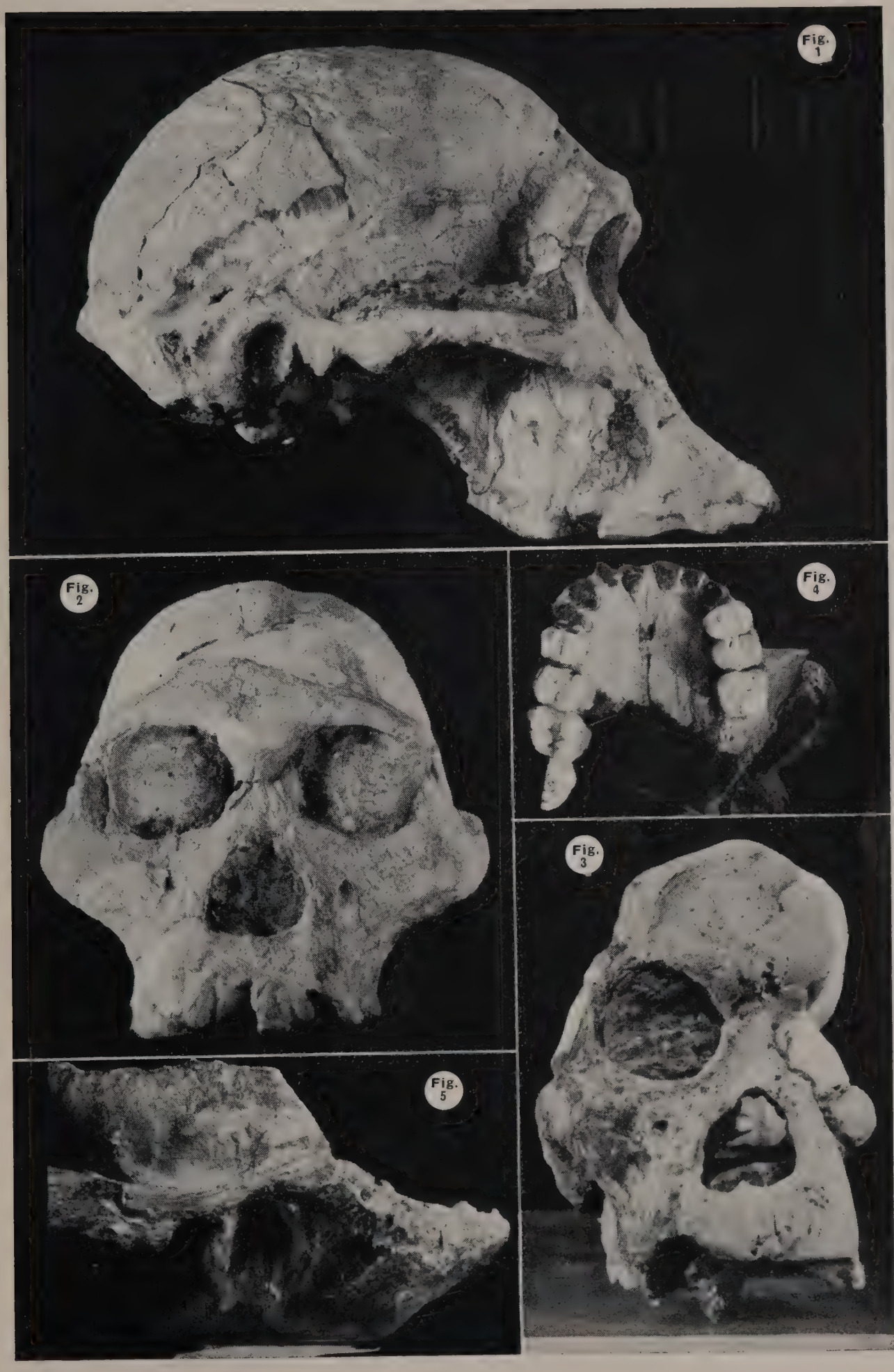
Fig. 1
Fig. 2
Fig. 4
Fig. 3
Fig. 5

PLATE 2.

FIG. 6. Upper view of skull of female *Plesianthropus transvaalensis* (Broom). Skull 5. About half natural size.

FIG. 7. Under view of skull of female *Plesianthropus transvaalensis* (Broom). Skull 5. About half natural size.

FIG. 8. Upper side of base of skull of *Plesianthropus transvaalensis* (Broom). Skull 8. Natural size.

FIG. 9. View of upper end of right humerus and of outer third of right scapula of large male *Plesianthropus transvaalensis* (Broom). Part of skeleton belonging to same individual as large mandible. Two-thirds natural size.

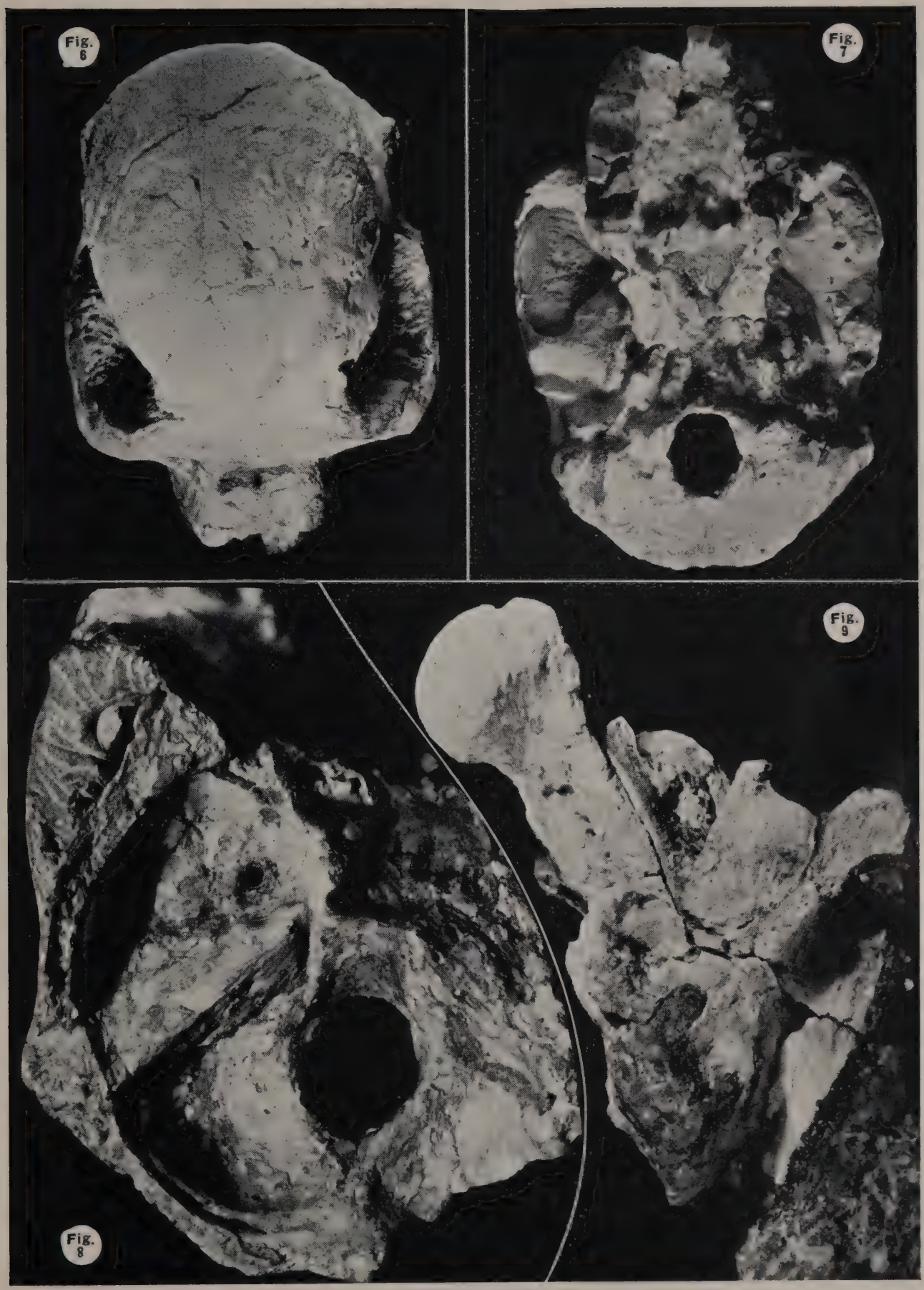
Fig. 6
Fig. 7
Fig. 8
Fig. 9

PLATE 3.

FIG. 10. Underview of base of skull of *Plesianthropus transvaalensis* (Broom). Skull 8. Natural size.

FIG. 11. Front view of imperfect skull of *Plesianthropus transvaalensis* (Broom). Skull 6. Two-thirds natural size.

FIG. 12. Lingual view of left upper canine of male *Plesianthropus transvaalensis* (Broom). An isolated tooth. Twice natural size.

FIG. 13. Occlusal view of left upper canine of male *Plesianthropus transvaalensis* (Broom). Twice natural size.

FIG. 14. Buccal view of left deciduous incisors and canine of young child *Plesianthropus transvaalensis* (Broom). Probably male. The 1st incisor is displaced. Twice natural size.

FIG. 15. Buccal view of 1st and 2nd left upper deciduous molars of young child *Plesianthropus transvaalensis* (Broom). Twice natural size.

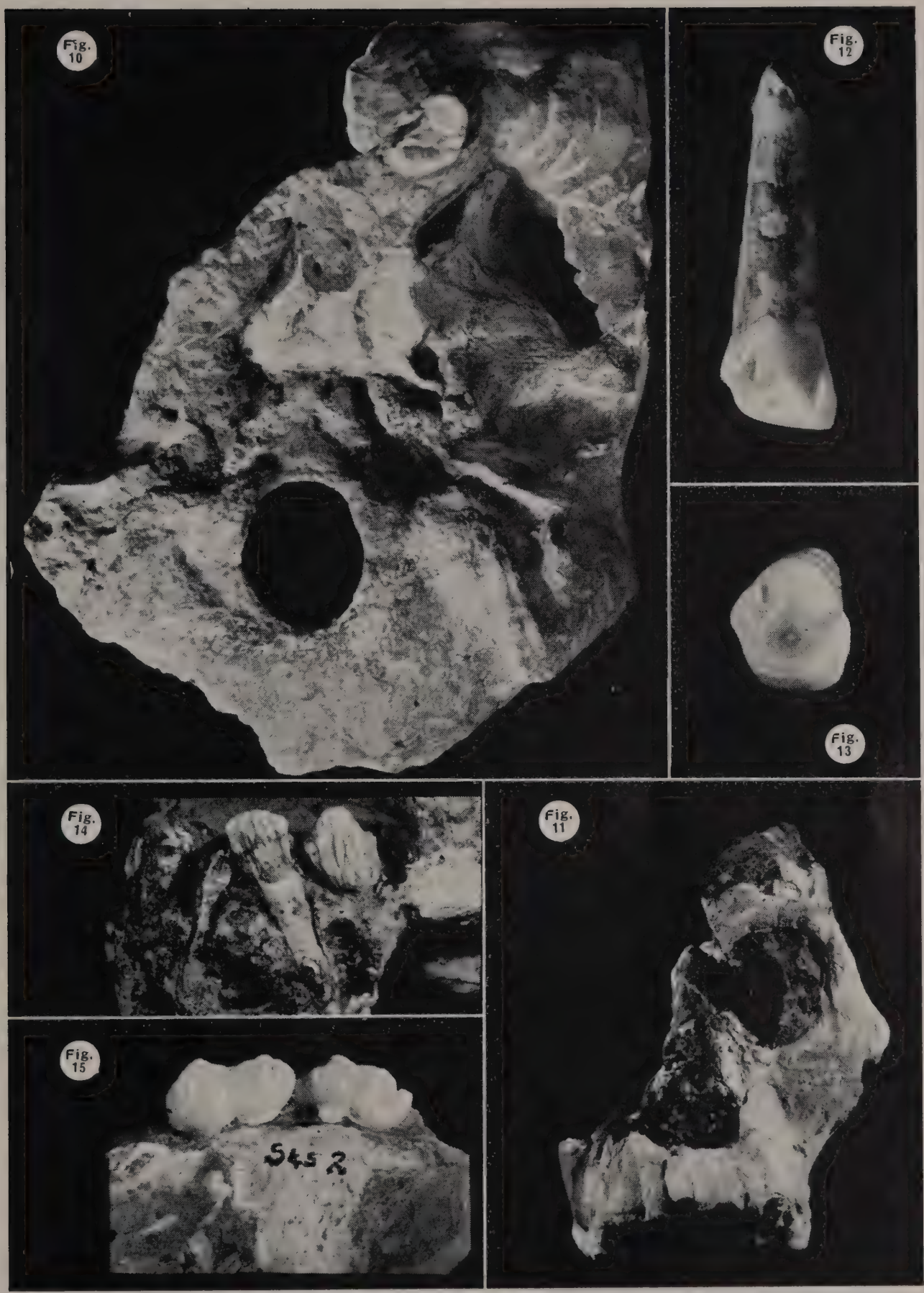
Fig. 10
Fig. 12
Fig. 13
Fig. 14
Fig. 11
Fig. 15
545 R

PLATE 4.

FIG. 16. Upper view of base of skull of *Plesianthropus transvaalensis* (Broom). Skull 5. Natural size. A small piece of matrix has been left in left cerebellar fossa.

FIG. 17. Palatal view of crushed anterior part of skull of adolescent male *Plesianthropus transvaalensis* (Broom). Natural size. The 2nd. left molar shows marked indications of a cingulum which forms a Carabelli pit and an incipient cusp.

FIG. 18. Occlusal view of 1st and 2nd right lower diciduous molars, and of 1st right lower permanent molar of child *Plesianthropus transvaalensis* (Broom). Natural size. In front of the 1st deciduous molar is seen the crown of the right deciduous canine, but it is badly displaced, and seen obliquely.

FIG. 19. Occlusal view of 1st and 2nd left upper molars of *Plesianthropus transvaalensis* (Broom). Probably female. Twice natural size. The 2nd molar shows a very distinct Carabelli cusp.

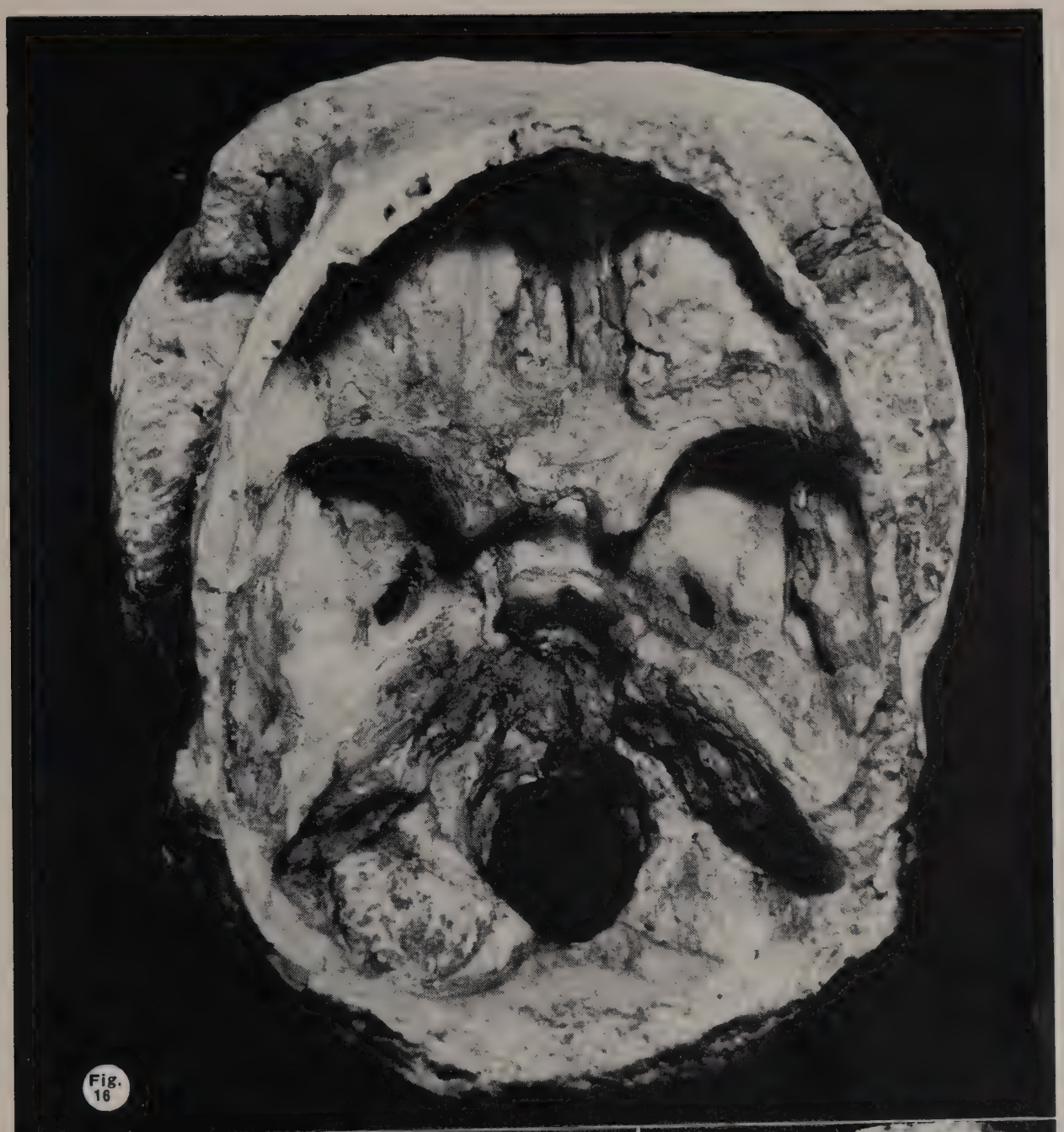
Fig.
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Fig.
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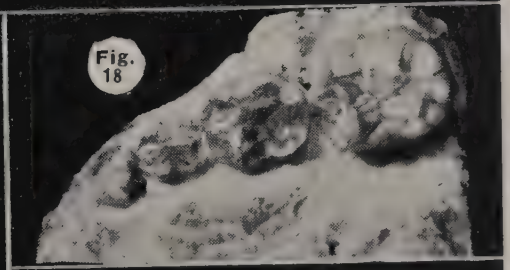
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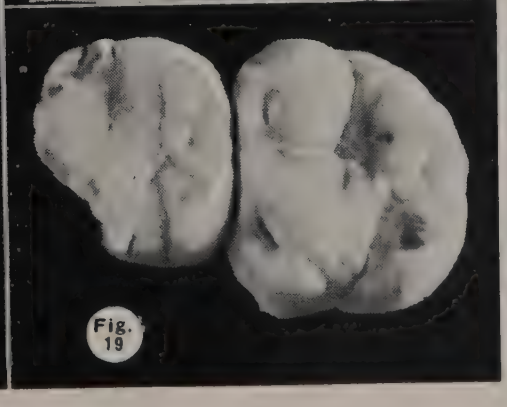
Fig.
19

PLATE 5.

FIG. 20. Outer side view of left ramus of mandible of male *Plesianthropus transvaalensis* (Broom). Natural size. Behind the upper part of the jaw is seen the matrix supporting the crushed ascending ramus of the right side, which is coextensive with the whole of the upper part of the matrix shown.

FIG. 21. Inner view of the left ascending ramus of the jaw of the male *Plesianthropus transvaalensis* (Broom). The posterior part and condyle are missing. The lower part fits on to the horizontal ramus shown in fig. 20. Near the lower and anterior end are seen two rounded marks: these are the impressions of the two mental foramina.

FIG. 22. Occlusal view of the lower jaw of male *Plesianthropus transvaalensis* (Broom). Natural size. The right horizontal ramus is crushed into the inner side of the left. The 1st and 2nd right molars are shown but the 3rd is hidden by the matrix supporting the right ascending ramus. The line that extends to the lower right hand corner of the photograph is a section of the ascending ramus.

Fig.
20

Fig.
21

Fig.
22

PLATE 6.

FIG. 23. Anterior or inner view of right os innominatum of probably female *Plesianthropus transvaalensis* (Broom). Two-thirds natural size. The top of the outer part of the ilium is a little crushed, and the pubis has been broken a little below its acetabular part, and the whole of the lower parts of the pubis and ischium are displaced. They are photographed as preserved. In the text a restoration is given of the os innominatum with the displacement corrected.

FIG. 24. Outer or posterior view of the os innominatum of *Plesianthropus transvaalensis* (Broom). Two-thirds natural size.

FIG. 25. Anterior or acetabular view of pelvic bones of *Plesianthropus transvaalensis* (Broom). Two-thirds natural size. The upper and anterior part of the acetabulum is seen running up to the inferior spine — a non-human character; and the ischial tuberosity is also seen to be differently shaped from that in modern Man.

FIG. 26. Inner view of pelvic bones of *Plesianthropus transvaalensis* (Broom). Two-thirds natural size. The sacral articulation is seen to differ markedly from that in modern man; and the orientation of the iliac inner surface to the plane formed at the back of the acetabulum and ischium is also seen to differ markedly from that in modern Man.

FIG. 27. Anterior view of right humerus of male *Plesianthropus transvaalensis* (Broom). Half natural size. The middle part of the shaft is badly crushed and the lower part broken and somewhat displaced.

Fig.
23

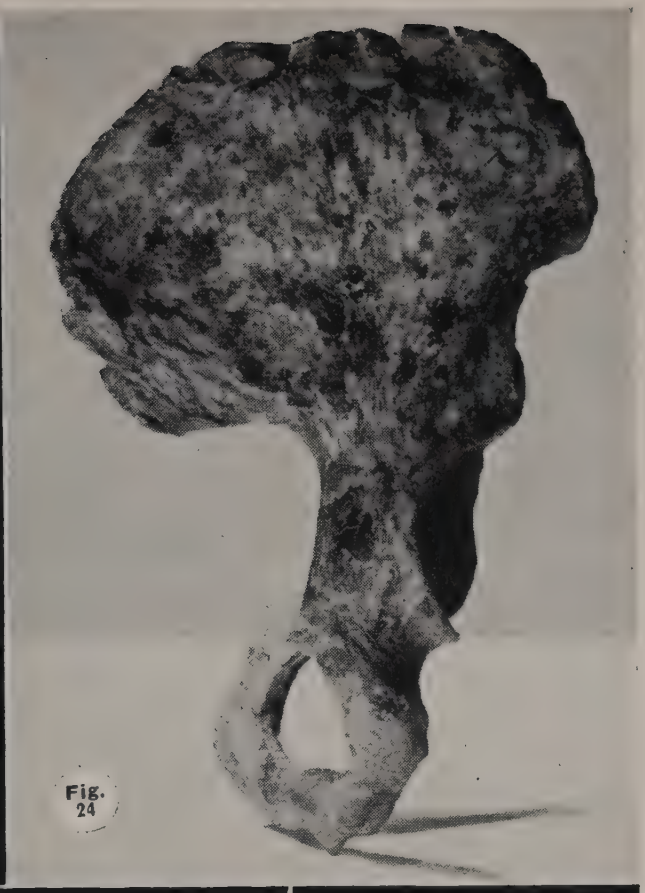
Fig.
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Fig.
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Fig.
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Fig.
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PLATE 7.

Dr. Broom examining Plesianthropus skull No. 5 immediately after discovery.

Still embedded in the breccia is the major portion of the skull with the floor of the brain cavity showing. Above, in the counterslab, is the roof of the brain cavity.

PLATE 8.

The numbered areas mark the positions of some of the more prominent finds; the stippled area indicates the region from which isolated teeth have been recovered. The figures, in feet and inches, after the identifications below represent the depth below the position of the skull marked 9 in the map.

1. "Mrs. Ples," Plesianthropus skull No. 5 (2′ 4″).
2. Two very good teeth (2′).
3. Mandible — see Plate 5 (4″).
4. Crushed skull (3′ 9″).
5. Pelvis (3′ 9″).
6. Skull (3′).
7. Skull (3′ 6″).
8. Young mandible (4′).
9. Skull 6 — see Plate 3, fig. 11; Plate 1, fig. 4 (Zero).
10. Calvarium (2′ 5″).
11. Skull 7 — see Plate 1, fig. 3 (5′ 5″).

12.—13. Fragments of two skulls (5′ 6″).

14. Maxilla with teeth (5′ 8″).
15. Femur (6′ 10″).
16. Mandible (5′ 8″).
17. Skull No. 8 — found in rubble dump.

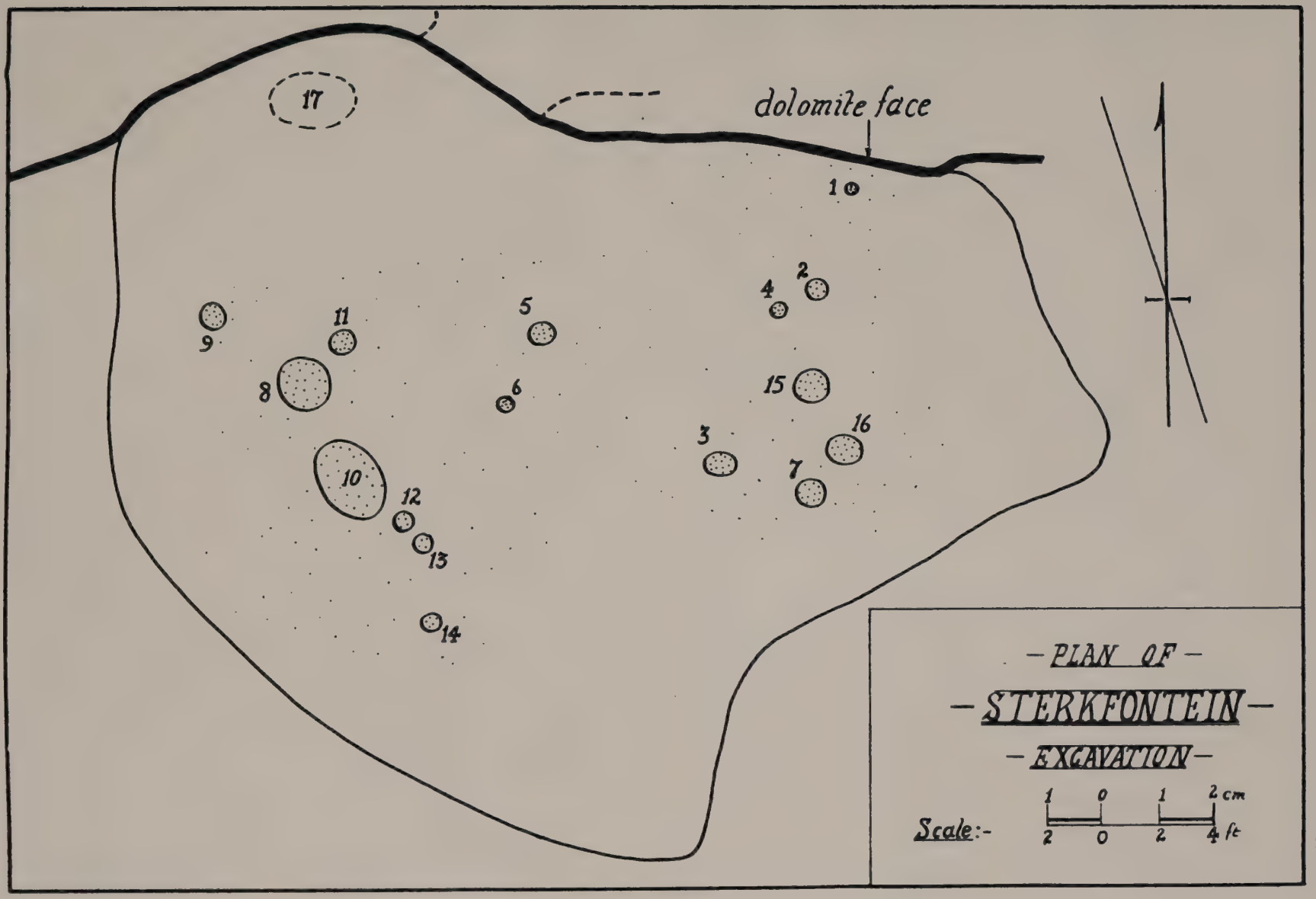
17
dolomite face
1
2
4
5
9
11
8
6
15
16
3
7
10
12
13
14
— PLAN OF —
— STERKFONTEIN —
— EXCAVATION —
Scale:-
1 0 1 2 cm
2 0 2 4 ft

PLATE 8.

Part II

The Brain Casts of the Recently Discovered

PLESIANTHROPUS SKULLS

by

G. W. H. SCHEPERS, D.Sc., M.D.

(Johannesburg, S. Africa)

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THE BRAIN CASTS OF THE RECENTLY DISCOVERED PLESIANTHROPUS SKULLS

INTRODUCTION

THE GREAT VALUE of the *Plesianthropus transvaalensis V* endocast lies in the fact that it has been obtained from a perfect skull which is definitely indentifiable as that of an elderly female. Only the right parieto-occipital as well as the left central and parietal portions are in natural limestone, being the large lining flakes which it has been possible to preserve in the process of cleaning out the endocranial cavity. But fairly good surface representations of the whole frontal, temporal, cerebellar and occipital regions of the right side have been obtained, and it is possible now to visualise a further specimen of an Australopithecid brain without being perplexed by any distortions or missing parts The gain in this direction, however, is offset by some loss in surface detail, a feature which was so excellently preserved in the case of *Plesianthropus transvaalensis* II and in *Australopithecus africanus* (Broom and Schepers, 1946).

Surface relief is better preserved in the frontal fragments of the natural limestone cast representing the brain of *Plesianthropus transvaalensis VII*. This specimen supplies us with all the data necessary to visualise the right frontal lobe perfectly and to reconstruct the parietal and temporal regions, for there is considerable evidence of crushing in the lower parietal and upper temporal lobes. The temporal pole can be completely represented because an accurate contact could be established with the middle temporal fossa of the corresponding skull. After cleaning out the occipital fossa a somewhat distorted and imperfect cast could be made out of the posterior surfaces of the cerebellum as far as the transverse venous sinuses, and of the cerebral occiput; and because of the accuracy of the contacts and orientation of the frontal portion, the whole brain of *Plesianthropus VII* could be satisfactorily reconstructed. But there is no worthwhile surface relief in these posterior regions.

In the case of *Plesianthropus transvaalensis VIII* the brain had to be reconstructed by the addition of an almost perfect cast of the posterior and middle cranial fossae to an accurate impression made from the posterior two-thirds of the calvarium. There is so little missing between these two fragments that the cerebellum, occiput, parietal and temporal lobes can be completely represented. The length of the frontal lobe can be estimated and its contours completed by continuing those of the known parts. The surface markings are rendered with less fidelity than was at first hoped, but the valuable contoural data minimises this loss. However, seeing that anatomists tend to be sceptical about

the interpretation of cerebral convolutional patterns, it is quite a relief not to feel obliged to venture further detailed interpretations at this juncture. I must nevertheless affirm that the general features ascertainable in the present series of casts compel me to detract nothing from my previous analyses; indeed they have clarified several issues of cerebral evolution which have thus far remained obscure. The discovery of these new specimens happily confirms most of the reconstructions necessitated by the defective nature of the earlier material, and establishes that many estimates of the Australopithecid brain previously made have been on the conservative side.

ENDOCRANIAL CAPACITY

THE "MISSING LINK" brain volume still remains a moot question. If a giant Gorilla of some six hundred pounds in weight has a brain volume of 650 cc. and if forest giants like the primitive arch-anthropines *Pithecanthropus erectus* or *Pithecanthropus robustus* have endocranial capacities ranging from 775 cc. to 900 cc., must the "missing link" necessarily have a brain capacity of more or less 700 cc.? This question applies particularly to a case where the skull is that of a small, frail female of the species. Though *Pithecanthropus* has many simian features, perhaps more strikingly so than the *Australopithecidae,* I would not demand a re-classification of the Type on such inadequate grounds. The brain of *Homo sapiens* varies in volume over a range of 800 cc. to 2,500 cc. By the same token *Pithecanthropus* may yet remain an archanthropine should specimens be found with skull capacities of less than 700 cc., provided there is proof that such specimens are females of correspondingly less bulky somatic proportions.

Much light on this subject is shed by the new *Plesianthropus* data (TABLE I). Dr. Broom recently recovered a massive jawbone which undoubtedly belongs to a male of the same species. Thus all our specimens so far must belong to females; and these are already shown to have had brains exceeding the simian brain in volume. The male brain very likely was considerably larger and in exceptional cases may have reached 700 cc. This issue can, however, not be settled until the endocast of a fully grown male *Plesianthropus* comes to hand, though it seems unlikely that this estimate be in error, having regard to the fact that the male brain is always larger than that of the female in the Primate series. Meanwhile the available material has provided incontrovertible evidence that a fair sampling of Australopithecid brains, seven in all, yields an approximate average brain volume in excess of 600 cc., with a potential range of 400 — 750 cc., whereas the Anthropoid Ape average (male and female) brain size is about 450 cc., with a range of 300 to 650 cc., the maximum capacity being that of an exceptional individual. Here then we have an absolute volumetric distinction between Apes and Man-Apes which cannot be disposed of by any dialectic sophistry, however biassed or brilliant. The Australopithecid range has by no means overlapped that of the *Hominidae,* as presently conceived; had this been the case the sceptics might be able to say that we are dealing with mere Hominids. Let us recognise for the present, however, that the *Australopithecidae* form, on the basis of brain size alone, an important Family between the Simian and Hominid Primate Families.

Though the *Australopithecidae* remain relatively nearer the *Simiidae* than to the *Hominidae* in respect of absolute brain volume, the principle involved in the determin-

TABLE I.

COMPARATIVE BRAIN VOLUMES.

	PRIMATE TYPE		Approximate Average Volume (cc.)	Range (cc.): possible or actual	Cephalisation coefficient
SIMIIDAE	Orang-utan		400	300—500	3—7
	Chimpanzee		410	320—500	6—9
	Gorilla		500	410—650	2—5
	Average		**450**	**300—650**	**2—9**
AUSTRALOPITHECIDAE	Plesianthropus transvaalensis	I (F)	440—460		
		II (F)	520—540		
		V (F)	480*		
		VII (F)	480—520		
		VIII (F)	550—570		
		Average (Approx.)	600	400—700	10—14
		F	500	400—600	
		M	650	600—700	
	Australopithecus africanus — Juvenile		510—530		
	Average (Approx.): Adult		650	550—750	12—16
		F		550—650	
		M		600—750	
	Paranthropus robustus		650	550—750	12—16
	Average (Approx.): F			550—650	
		M		600—750	
	Average Australopithecid		**600—650**	**400—750**	**10—16**
HOMINIDAE	Pithecanthropus		900 (approx.)	700—1100	14—16
	Sinanthropus		1000 „	800—1300	15—17
	Homo neanderthalensis		1500 „	1200—1700	18—22
	Homo sapiens (recens et fossilis)		1150—1850	800—2500	25—50

* Endocranial capacity of Plesianthropus V as determined by Dr. Broom.

TABLE II.

ENCEPHALIC DIMENSIONS.

DIMENSIONS		SIMIIDAE				AUSTRALOPITHECIDAE									HOMINIDAE				
						Plesianthropus					Paranthropus Juvenile Australopithecus Adult (hypothetic) Australopithecus								
		Chimpanzee	Orang-utan	Gorilla	**Average**	I	II	V	VII	VIII				**Average**	Pithecanthropus	Sinanthropus	H. neanderthalensis	H. sapiens (Bushman)	**Maximum**
Length	Cerebral	103	106	125	**111**	118	130	121	124	132	140	125	140	**130**	157	163	190	165	**210**
	Pre-sylvian	27	32	25	**28**	35	43	43	43	48	44	40	46	**43**	48	50	51	45	**58**
	Post-sylvian	74	78	100	**84**	80	87	78	81	86	96	85	95	**86**	109	113	139	120	**152**
	Cerebello-sylvian	78	76	97	**84**	76	—	77	78	75	88	79	85	**79**	97	98	112	104	**137**
Width	Bi-frontal	64	61	71	**66**	82	79	76	76	82	88	76	88	**80**	91	97	119	106	**126**
	Bi-parietal	76	72	83	**77**	88	84	82	90	98	108	92	104	**94**	110	114	130	124	**150**
	Bi-temporal	84	91	99	**91**	100	94	92	100	104	106	90	100	**100**	126	129	146	134	**146**
	Temporal lobe	25	28	29	**27**	30	36	33	32	32	33	27	32	**33**	35	30	40	37	**51**
Height	Cerebral	72	78	77	**76**	79	84	87	84	87	90	78	90	**85**	95	99	123	105	**148**
	Sylvian	47	55	59	**54**	47	53	57	56	58	61	53	58	**56**	61	64	80	68	**90**
	Parietal	56	53	58	**56**	56	56	58	60	63	64	57	64	**59**	66	72	92	78	**105**
	Sylvian angle Approx. 5°	100	105	140	**115**	70	80	60	50	70	50	80	50	**60**	80	70	45	20	**5**
Cerebral Sectors	Orbital	40	42	47	**44**	54	53	57	58	—	—	54	60	**56**	63	67	74	65	**78**
	Frontal	55	60	60	**58**	65	80	83	80	—	—	70	80	**76**	78	85	107	96	**130**
	Parietal	35	42	36	**37**	57	60	54	65	68	—	73	77	**66**	80	77	92	95	**114**
	Occipital	55	53	40	**49**	38	—	34	34	40	—	30	36	**36**	50	51	60	44	**43**
	Occipito-temporal	85	94	103	**94**	80	—	91	88	92	103	94	100	**93**	113	117	150	122	**154**
	Temporo-sylvian	24	34	27	**28**	24	30	30	23	24	27	21	27	**26**	37?	26	33	25	**35**
	Sagittal circumference	280	300	320	**300**	330	360	360	340	370	390	330	390	**360**	410	420	540	430	**580**
Cerebellar	Length	32	36	45	**38**	33	—	35	36	43	49	38	48	**41**	57	63	64	57	**83**
	Width	74	68	80	**77**	82	—	74	78	75	80	66	80	**79**	107	103	120	113	**124**
	Height	26	30	34	**30**	24	—	23	27	28	27	22	28	**25**	34	33	32	27	**42**

ation of the Cephalisation Coefficient shows that just the converse obtains, i.e. the Australopithecids are more Human than Ape-like in respect of relative brain equipment. Very approximate Cephalisation Coefficients can be compared by employing the crude formula:

$$Cephalisation\ Coefficient = \frac{Brain\ weight}{Body\ weight} \times 1000.$$

The specific gravity of neural tissue is known, so that brain weight (in grams) can be read approximately when the cubic capacity has been determined. The body weight (in Kilograms) of fossils can also be computed by using any of the many anthropometric formulae designed for this purpose; and sufficient of the bones of the *Australopithecidae* are already known to justify the exploitation of approximate estimates of body weight in such formulae. Thus the Simian cephalisation coefficient never reaches 10 (some lower Primates yield much higher values for this index); the Human coefficient may be as low as 14 in the case of the gigantomorph Pithecanthropids, but may reach the astounding figure of 50 in the macrocephalic pedomorphic Zitzikama pre-Bushman race of South Africa. The Australopithecid range is decidedly of intermediate value, with a distinct leaning towards the Hominid range. The conjectural nature of this evidence is by no means overlooked, but even allowing for a considerable margin of error we can rest assured that the *Australopithecidae* had achieved a degree of brain evolution which lifted them well out of the Simian ranks, though on these grounds alone one cannot yet say, with complete certainty, how closely they approximated the Human stage of development.

ENCEPHALIC DIMENSIONS

CONSIDERATION OF THE metrical data assembled in TABLE II enables one to realise how very different the Australopithecid brains are from those of the *Simiidae*. The average values for the *Australopithecidae* are invariably intermediate between those of Man and the Apes. In a few cases the averages are not much beyond the simian range (e.g.: the post-sylvian length, bi-temporal width, vertical height at the sylvian fissure, the cerebello-sylvian and occipito-temporal diameters, the temporo-sylvian depth, and the bi-cerebellar width measurements); but only in the case of the cerebellar height and the projected occipital arc or sector is the actual Australopithecid average dimension less than that of the Anthropoid, and in both instances do these reductions indicate a Hominid trend. The smallness of the sylvian angle is similarly an index of specialisation or differentiation in the Human direction, and the very small angles obtained in the *Australopithecidae* constitute an almost pathognomonic sign of the high evolutionary status of this Family.

The increased cerebral length is largly due to the exaggerated pre-sylvian length so characteristic of these Man-Ape brains; the frontal lobe is quite as long as that of Man, although its width, while greatly expanded as compared to the Ape brain, is not yet within the Pithecanthropid range.

The bi-parietal expansion is a highly significant advance, and is in excess of the lateral growth at the bi-temporal plane, so that it indicates a specific developmental trend in the *Australopithecidae* quite apart from the general lateral growth tendency. The

increased width of the temporal lobe is matched by equal expansion in the depth of the frontal lobe.

The general cerebral height shows a particularly significant gain, partly owing to an increased height in the parietal region, and partly owing to greater depth of the temporal lobe and the greater curvature of the cerebrum along its horizontal axis.

The altered proportions of the cerebrum are excellently demonstrated by the comparative figures for the circumferential sectors. The frontal lobe shows the greatest advance, as reflected by the increased orbital and frontal arcs, and there is much expansion of the parietal sector, with corresponding reduction of the occipital lobe. And the over-all sagittal projected circumferential increase reflects the greater general size of these Australopithecid cerebri as compared with the corresponding Anthropoid brain parts.

The cerebrum, however, though a little longer and wider but less high, retains the simian dimensions.

VOLUMETRIC AND PLANIMETRIC INDICES

THE LACK OF DEVELOPMENT in the cerebellar region emphasizes the significance of the forebrain development in the *Australopithecidae,* when the mid- and hindbrain volumes are contrasted with the forebrain volume in a series of indices (Table III). The average Australopithecid forebrain is now seen to be relatively large, i.e. the all important Forebrain Index is as high as, or higher than the average for the *Hominidae;* and amongst Primates this evolutionary achievement is shared only by the Tarsier, in which the cause is undoubtedly the relative reduction in the mid- and hindbrain, associated with the creature's saltatory propensity. But the point to be emphasized here is the wide gap between the Anthropoid and the Australopithecid volumetric indices.

The great relative expansion of the frontal lobe and parietal lobe in the *Australopithecidae* is clearly demonstrated in the comparative Table of planimetric indices. These indices are of necessity only approximate, yet they serve to stress such marked differences. The expansion of the frontal lobe is an absolute gain in which the Man-Apes achieve the Hominid range of development. The excessive development of the parietal lobe is at the expense of the occipital lobe, the latter showing an absolute as well as a relative reduction as compared with the simian state of affairs. The reduction of the temporal lobe is within the range of Human proportions, despite an actual gain in its absolute surface area, as compared with the Anthropoid brain.

Thus there is a total transformation in the cerebral hemispheres which brings the *Australopithecidae* to the immediate doorstep of Hominid status.

BRAIN PROPORTIONS.

CLOSER SCRUTINY of the encephalic indices compounded by comparing the various cerebral and cerebellar dimensions listed in Table II confirm these observations. These indices fall into two groups: those assembled in Table IV all reflect the intermediate status of the Australopithecid brains, while those listed in Table V are interest-

TABLE III.

ENCEPHALIC INDICES.

	PRIMATE TYPES	VOLUMETRIC INDICES		PLANIMETRIC INDICES			
		Forebrain	Mid- and Hindbrain	Frontal Lobe	Temporal Lobe	Parietal Lobe	Occipital Lobe
SIMIIDAE	Chimpanzee	83	17	30	40	17	13
	Orang-utan	83	17	29	43	14	14
	Gorilla	84	16	29	40	16	15
	Average	**83**	**17**	**29**	**41**	**16**	**14**
AUSTRALOPITHECIDAE	Plesianthropus I	86	14	39	33	20	8
	Plesianthropus II	86	14	38	32	20	10?
	Plesianthropus V	89	11	37	34	20	9
	Plesianthropus VII	87	13	35	35	21	9
	Plesianthropus VIII	88	12	37?	33	19	11
	Paranthropus	86	14	—	33	—	—
	Australopithecus	88	12	34	33	23	10
	Average	**87**	**13**	**37**	**33**	**20**	**10**
HOMINIDAE	Pithecanthropus	84	16	34	35	16	15
	Sinanthropus	84	16	35	32	17	16
	H. neanderthalensis	85	15	38	34	15	13
	H. sapiens (Bushman)	89	11	43	31	16	10
	Average	**86**	**14**	**38**	**33**	**16**	**13**

TABLE IV.

BRAIN PROPORTIONS.

	INDICES %	Cerebral height / Cerebral length	Bi-frontal width / Bi-parietal width	Occipito-temporal length / Bi-temporal width	Sylvian height / Parietal height	Sylvian height / Bi-frontal width	Temporo-Sylvian length / Parietal height	Temporo-Sylvian length / Orbital sector	Cerebellar length / Cerebello-Sylvian length	Cerebellar height / Cerebral height	Parietal sector / Frontal sector	Temporo-Sylvian length / Sagittal circumference	Temporo-occipital length / Sagittal circumference	Occipital sector / Sagittal circumference	Parietal sector / Sagittal circumference	Frontal sector / Sagittal circumference	Orbital sector / Sagittal circumference
SIMIIDAE	Chimpanzee	70	84	100	84	73	42	60	41	36	64	9	31	20	12	20	14
	Orang-utan	74	82	103	104	90	64	81	42	38	70	11	32	18	14	20	14
	Gorilla	62	86	104	102	83	47	58	45	44	60	9	32	13	11	19	15
	Average:	**68**	**84**	**102**	**97**	**82**	**49**	**67**	**43**	**39**	**65**	**9**	**32**	**17**	**12**	**20**	**14**
AUSTRALOPITHECIDAE	Plesianthropus I	61	93	80	84	62	43	44	50	30	88	8	25	12	18	21	14
	Plesianthropus II	67	93	—	95	66	53	56	—	—	75	8	—	—	17	22	15
	Plesianthropus V	72	93	99	99	75	52	53	45	26	80	8	25	10	17	23	16
	Plesianthropus VII	66	84	86	92	74	39	40	46	32	85	6	26	10	19	21	16
	Plesianthropus VIII	66	84	89	92	71	38	—	53	32	—	6	25	11	18	—	—
	Paranthropus	64	80	104	95	69	42	—	55	30	—	7	26	—	—	—	—
	Australo- (a) Juvenile	62	95	97	93	70	37	39	49	32	104	6	27	9	21	21	16
	pithecus (b) Adult	64	85	100	91	66	42	45	56	28	96	7	26	9	20	21	15
	Average:	**65**	**87**	**93**	**93**	**69**	**43**	**46**	**51**	**30**	**88**	**7**	**26**	**10**	**19**	**21**	**16**
HOMINIDAE	Pithecanthropus	60	91	90	92	67	36	?43	59	36	102	?6	27	12	20	19	15
	Sinanthropus	63	93	91	89	66	36	39	64	33	91	6	28	12	20	20	16
	H. neanderthalensis	65	92	102	87	67	36	45	57	26	86	6	28	11	18	20	14
	H. sapiens (Bushman)	64	85	91	87	64	32	38	55	26	99	6	28	10	22	22	15
	Average:	**63**	**90**	**93**	**89**	**66**	**35**	**41**	**59**	**30**	**94**	**6**	**28**	**11**	**20**	**20**	**15**

ing in so far as they reveal " ultra-hominid " specialisations, except the last three or four which indicate a reversion to Simian proportions. The features emphasized in these Tables are really self-evident, but they require detailed scrutiny. If we read only the averages for the Apes, Man-Apes and Man, the following interpretations are suggested: Owing to the elongation of the brain the height index remains relatively low in Man and in the Man-Apes, despite the greater absolute cerebral height in both. And despite the increased bi-parietal width in the Australopithecids and in Man, the ratio of bi-frontal development increases progressively from Ape to Man. Further, despite the similarity in the occipito-temporal length of the Apes and Man-Apes, the ratio of this dimension to the bi-temporal width falls to Human levels in the *Australopithecidae* through an absolute gain in the latter dimension.

INTERMEDIATE PROPORTIONS.

In the Human brain there is an increase in both the sylvian and parietal cerebral heights, the latter more than the former. The difference is less in the Australopithecid brain and least in that of the Anthropoid Apes, with the exception of the Chimpanzee where the sylvian height is rather low. Though the Australopithecid average index approximates that of Man, the two brains are nevertheless not strictly comparable, for the low value in the case of Man is attributable to the greater hypsencephaly of the parietal region, while in the Man-Ape the reading can be partly ascribed to the relative elongation of the frontal lobe region.

Moreover, the expansion in the width of the frontal lobe is an expression of its specialisation in the Human direction, and the index compounded from the sylvian height and bi-frontal width illustrates this point.

The components of the total cerebral height measurement can be analysed by comparing the temporo-sylvian and the parietal height dimensions. Thus it is demonstrated that the small gains in the parietal height of the Man-Apes is a growth trend of human significance because coupled with reduced temporo-sylvian projection of the temporal lobe.

Attention has been drawn to the reduction of the sylvian angle in the *Australopithecidae* and Man. This change is wrought by the approximation of the two arms constituted by the contour arc of the temporal pole and the descending orbital margin. But these " arms " at the same time alter in relative length, the temporal sector becoming shorter and the orbital length increasing in the Australopithecids and in Man. This is emphasized in TABLE IV by the decreasing index for these values.

The relationship of the Australopithecid cerebellum to the cerebrum also shows distinct advances in the Human direction. The slightly increased cerebellar length is associated with a correspondingly reduced cerebello-sylvian length consequent on the greater longitudinal curvature of the cerebrum by which the cerebellum is underslung more completely below the cerebrum. Consequently the index between these two measurements has a value intermediate between the Anthropoid and Human ranges, which are relatively far apart. The ratio of the cerebellar height to the cerebral length is lower in Man than in Anthropoids; the Australopithecid average falls within the Human range.

The last seven indices of TABLE IV deal with the proportions of the cerebral lobes to one another and to the total sagittal circumference. The contrast between the parietal and frontal sectors is particularly striking, for these are both areas undergoing considerable expansion in Human evolution. It is therefore to be expected that the Simian average should be relatively low and that of Man quite high. The *Australopithecidae* have a ratio consistently above the Anthropoid range and approximating the Human index. As deducible from the ratios between the frontal and orbital sectors on the one hand, and the sagittal circumference on the other, the great advance in the frontal lobe of the *Australopithecidae* and Man is in harmony with the expansion of the cerebrum as a whole. But the evolutionary growth of the parietal lobe takes place at a rate exceeding that of the remaining parts, thus accounting for the high parieto-frontal index and the almost doubled ratio between the parietal sector and sagittal circumference. The value obtained for the *Australopithecidae* place these Man-Apes within the Human range in these respects. To balance these trends it may be observed that despite increased general dimensions in the temporal and occipital lobes the relative expansion here is less in the *Australopithecidae* and Man than in the Apes. The reduction in the *Australopithecidae* actually exceeds that in Man, though the difference is not great enough to be very significant.

ULTRA-HOMINID SPECIALISATIONS.

The latter remark applies to several of the indices in TABLE V, indicating a general tendency of the Australopithecid brains to achieve an ultra-hominid specialisation. Where the differences between the Apes and Man are considerable, the Australopithecid tendency may be disregarded, for a small margin of error may be assumed all along. For this reason the first three indices in this Table are not significant, except in so far as they reveal that the measurements involved retain a constant ratio in higher Primate Series. But the ratio of the occipito-temporal length to the cerebral length shows a sharp drop in the transition between Ape and Man, and the fact that the Australopithecid index is even lower than that of Man must be regarded as significant, the more so as the factor of error is less in the case of these major brain measurements than in others.

The excessively high ratio obtained between the pre- and postsylvian lengths of the cerebrum of the *Australopithecidae* again emphasizes the early differentiation of the frontal lobe in the Man-Apes, a fact which is further borne out by the wealth of convolutional detail in this lobe, as previously emphasized. But the elongation of the frontal lobe evidently takes place at a greater rate than the growth in the vertical and lateral directions, as is proved by the relatively high indices obtained in comparing the pre-sylvian length with the sylvian height and bifrontal width. But the lateral expansion in the frontal lobe is by no means inconsiderable in the *Australopithecidae,* for although it is by far not yet as great as that achieved in the *Hominidae* it is nevertheless, relatively to the lateral expansion in the temporal region and hindbrain, greater than the advance distinguishing Man from the Apes. In considering the latter two indices, cognisance must be taken of the fact that the average for the bi-temporal dimension is greater in the *Australopithecidae* than in the Anthropoid Apes, while the bi-cerebellar diameter shows little, if any, increase.

TABLE V.

BRAIN PROPORTIONS.

	INDICES %	Bi-parietal width / Cerebral length	Bi-frontal width / Cerebral length	Bi-temporal width / Cerebral length	Occipito-temporal length / Cerebral length	Pre-Sylvian length / Post-Sylvian length	Pre-Sylvian length / Sylvian height	Pre-Sylvian length / Bi-frontal width	Bi-frontal width / Bi-temporal width	Bi-frontal width / Bi-cerebellar width	Bi-parietal width / Bi-temporal width	Post-Sylvian length / Bi-parietal width	Post-Sylvian length / Bi-temporal width	Occipital sector / Occipito-temporal length	Parietal height / Bi-parietal width	Bi-cerebellar width / Bi-temporal width	Bi-cerebellar width / Cerebral length	Parietal height / Post-Sylvian length	Parietal height / Bi-temporal width
SIMIIDAE	Chimpanzee	69	62	81	83	37	58	42	76	86	90	97	88	65	74	88	31	76	67
	Orang-utan	68	57	86	89	40	57	52	67	90	79	108	86	56	69	76	34	68	58
	Gorilla	66	57	79	82	25	42	35	72	88	84	120	101	39	64	81	36	59	59
	Average:	**68**	**59**	**82**	**85**	**34**	**52**	**43**	**72**	**88**	**84**	**108**	**92**	**53**	**69**	**82**	**34**	**67**	**61**
AUSTRALOPITHECIDAE	Plesianthropus I	77	69	87	70	44	74	46	88	100	88	91	80	48	64	86	28	70	56
	Plesianthropus II	65	60	75	72	48	81	54	83	—	87	103	90	—	70	—	—	73	61
	Plesianthropus V	67	63	76	76	55	74	57	82	100	89	95	85	37	71	81	31	74	64
	Plesianthropus VII	71	60	80	69	57	77	57	76	99	88	90	80	39	66	69	28	74	59
	Plesianthropus VIII	74	62	79	70	56	83	58	79	110	94	88	83	44	64	72	33	73	61
	Paranthropus	78	63	76	74	46	72	50	83	100	104	89	90	—	58	83	35	67	60
	Australopithecus 1. Juvenile	64	61	72	70	47	75	53	85	110	89	92	94	32	71	75	30	67	63
	Australopithecus 2. Adult	74	63	71	71	48	79	52	88	115	104	91	95	36	62	80	34	67	64
	Average:	**72**	**64**	**77**	**71**	**50**	**77**	**54**	**84**	**105**	**94**	**92**	**87**	**39**	**65**	**75**	**31**	**70**	**61**
HOMINIDAE	Pithecanthropus	64	58	80	72	44	79	53	72	85	80	100	86	44	66	85	37	60	52
	Sinanthropus	64	58	73	72	44	78	52	75	94	81	100	88	44	69	80	38	64	56
	H. neanderthalensis	69	63	77	79	37	64	43	81	100	89	107	95	40	70	82	34	66	63
	H. sapiens (Bushman)	75	64	81	74	38	66	42	79	94	93	97	90	36	64	85	34	65	60
	Average:	**68**	**61**	**78**	**74**	**41**	**72**	**47**	**77**	**93**	**86**	**101**	**90**	**41**	**67**	**83**	**36**	**64**	**58**

The increased bi-parietal width is seen in its true perspective when contrasted with the expansion at the temporal level. The average for the *Hominidae* here given is as low as that for the *Simiidae,* because as the basis of my comparison only the lowermost three Hominid genera are used, while the South African Bushman values have been included for the sake of contrast, as an example of the Neoanthropine Sub-Family in its presumeably lowest form. Only in *Homo sapiens* the ratio between the bi-parietal and the bi-temporal diameters is as high as that recorded for the *Australopithecidae.* Indeed, many of the indices of TABLE V which appear to be ultra-hominid in character with reference to the few instances of primitive human brains here listed, are changes that are in keeping with the trend of Sapient Human cerebral development. This is probably the case with regard to the next few indices which deal with the relative expansions and altered proportions in the post-sylvian parts of the brain, the differences between the Australopithecid values on the one hand, and those of the Anthropoid Apes, Archanthropines and Palaeoanthropines on the other, reflecting cerebral morphogenetic trends decidedly in the Neoanthropine direction. The latter, however, is not invariably the explanation of the differences between the *Australopithecidae* and the *Simiidae* and *Hominidae.* Thus, in the case of the ratio between the bi-cerebellar width and the bi-temporal cerebral width, the Australopithecid value is actually less than that of the Apes, while there is very little difference between this ratio in Man and the Apes. But the lack of lateral growth of the cerebellum is the only instance in which the development of the *Australopithecidae* lags behind that of both Man and the Apes. This single difference cannot detract from the significance of the remarkable array of metrical data favouring an advanced neurophysiological evolutionary status for the South African Man-Apes.

CEREBRAL MORPHOLOGY.

THE GENERAL morphological character of the Australopithecid brains has already been presented in detail (Broom and Schepers, 1946). The new material confirms the main features and emphasizes the Hominoid character of this "missing link" brain.

Although the brain of *Plesianthropus transvaalensis V* (FIGS. 1, 2, 3) is small, being that of an elderly female of the species it shows a mixture of advanced and primitive features. Thus the cerebellum is a little less underslung, with reference to the cerebrum, than is the case with the other Man-Apes. On the other hand, the brain stem is deflected forwards as in Man. The brain is elongated and narrow towards the posterior half, but well-formed anteriorly. The orbital margins are particularly well defined and may be seen in FIG. 1 to descend below the occipito-sylvian base line, which is a characteristic Hominid feature. The rostral projection is relatively prominent, but Human rather than Simian in appearance. It is broad based and directed downwards and backwards, whereas that of the large Anthropoid is narrow and elongated and projects forwards. The temporal lobe is also prominent, being broad and flattened and showing evidence of the supernumerary sulcation previously observed in *Plesianthropus* II, though there is not such certainty here, as the markings are less clearly preserved. The temporal pole advances in front of the sylvian vertical plane, as in Man. The region of the speech area of Broca in the frontal lobe is about as well developed as in *Plesianthropus I,* but its precise boundar-

ies cannot be established, as the convolutional markings are inadequately preserved. The frontal lobe, however, is well developed, and there is a prominent bulge over the lower precentral area (" arm area ") and immediately in front of this. The parietal region is of almost equal extent, though not as full as in *Australopithecus*. The lunate sulcus (**18**) can be fairly clearly delineated, and there is sufficient moulding in the parieto-occipital area, immediately adjacent to the lambdoidal suture, to indicate that both the lunate sulcus and the parieto-occipital fissure (**21**) lie close together here, a disposition which is typically Human, as is the case with the other *Australopithecidae*.

The middle meningeal vascular pattern agrees with that of *Plesianthropus I* and *II*, having widely divergent anterior and posterior divisions, incomplete vascularisation of the occiput, indicating the possibility of a contributing posterior meningeal element, and showing some emphasis on the anterior division.

Such convolutional detail as was possible to interpret has been represented in FIGS. 1, 2 & 3. Certain of these sulci are sufficiently clearly marked to leave no question of their disposition, extent or identity (e.g. **1**, **3**, **4**, **5s**, **8**, **9**, **11**, **13**, **18**, **23**, **27**). Others are a little more vague and problematic. The possession of so many prominent sulci is a feature in favour of an advanced phyletic status. But the resemblance to the patterns previously described is less clear, and the brain is a little more primitive in so far as sulcus **11** is short and curves medially as it proceeds forwards, while sulcus **7** is more prominent and long and progresses medially and forward instead of laterally and downwards. In the parieto-temporal region the lack of a conspicuous parallel sulcus and the great distance of the lunate (**18**) from its equivalent region is a decidedly advanced convolutional feature.

PLESIANTHROPUS TRANSVAALENSIS VII.

IN THE CASE OF *Plesianthropus VII* we are again dealing with a brain in which convolutional detail is magnificently preserved in the frontal lobe (FIGS. 1 & 3). It is therefore a pity that crushing and distortion of the skull opposite the parietal and upper temporal regions should have interfered with identification of sulci and gyri here; for this lack makes diagnosis less certain more anteriorly. But it seems likely that at least sulci **1**, **2**(?), **3**, **4**, **5**(?), **7**, **9**, **11**, **12**, **13**, **23**, **27** are present in an arrangement as sketched in FIGS. 1 & 3. Possession of all these sulci, particularly when as fully developed as in the present instance, places the brain in the Australopithecid category which has already been shown to be pre-Hominid in character. Particular attention may be given to the marked expansion of the superior frontal convolution, as well as the inferior frontal convolution; the former runs forward parallel to the midline, and the latter shows evidence of subdivision into subsidiary convolutions. The general antero-posterior orientation of the convolutions may also be noted.

However, quite apart from the question of the identification of individual sulci, which is always a contentious point, the prominence of the lower frontal convolution is an advanced feature of this brain. It is thrown into excellent relief in photographs and imparts an angularity to the dorsal contour of the frontal lobe which is a characteristic shared with *Plesianthropus* II and the lower *Hominidae*. The effect on the orbital margin is to bring it into sharp prominence, as in Man, and to depress the whole of it to below

the occipito-sylvian base line, as in Modern Man. In conjunction with the forward growth of the temporal pole the final configuration of the region of the sylvian angle is entirely Human, indeed, practically Neoanthropic in pattern.

More posteriorly the detailed features of the brain of *Plesianthropus VII* can be less certainly established, but the general contoural characters can be visualised. The lunate sulcus and parieto-occipital fissure can be identified with even less certainty, but there is no reason to believe that they are in a position very much different from what appears to be the case in other *Australopithecidae*. The significant expansion of the parietal lobe and the reduction of the occiput confirm this interpretation. Another feature to be stressed is the underslung nature of the cerebellum which immediately imparts to the brain a human appearance.

Finally, the arrangement of the branches of the posterior division of the middle meningeal artery indicates clearly that the posterior meningeal vessel must have contributed to the supply of the occipital and some of the parietal dura. The reduction of the anterior division of the middle meningeal vessel is a surprising departure from the pattern thus far recognisable for the *Plesianthropus* and inclines to the arrangement in *Paranthropus* and the *Archanthropinae*.

PLESIANTHROPUS TRANSVAALENSIS VIII.

THE *PLESIANTHROPUS VIII* BRAIN (FIGS. 2 & 3) is more dolichencephalic than those of the preceding specimens which already showed a measure of elongation distinguishing them from the Anthropoid shape. The frontal lobe was not preserved in this specimen; this is unfortunate for it is clear that this is a highly advanced brain type. The great distance separating the lambdoidal and coronal sutures is a true index of the expansion of the parietal lobe. In reconstructing the outlines of the brain the frontal lobe had to be modelled on a combination of the characters of *Plesianthropus II* and *VII*. However, it may be that the estimate of the sylvian notch it too conservative and that the sylvian angle had been occluded in its first part, as in the case of *Paranthropus*. In such a case it may mean that the frontal pole may lie as much as a centimetre further forward, so that the frontal lobe would have to be enlarged in harmony with the expanded parietal lobe.

The manner in which the cerebellum has come to be shifted forward and below the cerebral occiput is most striking. The general arrangement is the same as that found in the human brain, especially in *Homo sapiens*. The broadened prominent transverse sinus overlying the cerebellum denotes the greatly increased vascular circulation through this expanded brain.

The broad, squat, curved temporal lobe, with its blunted pole so similar to that of *Paranthropus*, constitutes another remarkable feature of this cerebrum of *Plesianthropus VIII*. The indications are that it comprises the full three temporal convolutions, but there is no certainty about sulcal markings, despite the fact that the venous sinuses, trigeminal nerve and carotid artery are well preserved on the inferior aspect. The sulcal indentations over the parieto-occipital area suggest that the lunate sulcus (**18**) and parieto-occipital fissure (**21**) lie well back on the cerebrum, as in the other *Australopithecidae*. The parieto-occipital fissure is wide, and the convolutions bordering it are heaped up in

a manner suggesting marked proliferation of the peri-striate cortices and expanded upper parietal lobule.

The sulcal markings are not very distinct and their accurate identification is interfered with by the interruption between the upper and lower portions of the brain cast. But there can be no mistake about the lunate (**18**), parieto-occipital (**21**), *central* (**14**), interparietal (**16**), and superior post-central (**15s**), while the inferior temporal (**27**) is fairly clearly marked. On the whole the general disposition and individual features of these few sulci is in character with the Australopithecid anatomy, and, in this case, in an advanced degree of development.

CEREBRAL CONTOURS.

THE RELATIONSHIP of these new brain casts to the previously discussed Australopithecid specimens can be better appreciated by studying the series of superimposed cerebral contours of FIGURES 4 to 7.

FIG. 4 clearly shows that the dorsal contour at the frontal coronal plane is at a higher level than that established previously for *Plesianthropus I & II*. This was originally suspected, as there was some evidence of crushing in the former material. The more prominent rostral carina of *Plesianthropus V* and the greater lateral growth in the lower frontal plane in all three new specimens are all remarkable new features indicating even closer affinity between the *Australopithecidae* and Man.

At the parieto-temporal coronal plane (FIG. 5) the new fossil brains show further considerable advance in the Hominid direction. In the case of *Plesianthropus V* the outline at this level is a little narrower than that of *Plesianthropus I*. But the parietal height is much greater and the temporal lobe descends lower, so that the impression is that of greater hypsencephaly. Moreover, the fact that the outline of this brain is less than that of the Type in the post-sylvian plane, but greater at the pre-sylvian level, is a fact of considerable significance.

In the case of *Plesianthropus* VIII the brain contours at the parieto-temporal plane approximate the *Paranthropus* pattern. The prominence of the parietal lobe in *Plesianthropus VIII* is specially noteworthy, particularly as it is associated with a somewhat receding contour at the temporal level, which is a feature shared with *Australopithecus* and *Paranthropus*.

The dorsal contour studies (FIG. 6) confirm these analyses. The frontal contour of *Plesianthropus V* is not dissimilar to that of *Plesianthropus I* except that the former is the longer, while that of *Plesianthropus VII* compares well with that of *Plesianthropus II*, the frontal contour of *Plesianthropus VIII* being speculative. But the expansion in the post-sylvian part is now shown to be significantly greater in *Plesianthropus VIII* than in the Type specimens, approximating to the *Paranthropus* outlines. but the general Australopithecid pattern is preserved in these new specimens.

The lateral contour superimpositions (FIG. 7) stress certain of these points, while emphasizing others. The forward specialisation of the brain of *Plesianthropus V* is brought into further prominence, while is is clear that the adult *Australopithecus* would have shown greater expansion upwards and backwards, as is here hypothetically suggested. This surmise is justified by an analysis of not only the Type juvenile specimen, but also by

taking cognisance of the fact that this is the trend already manifest in the larger Plesianthropines (*II & VIII*). By analogy with *Plesianthropus V* the temporal pole may also have been much longer than is evident from the immature specimen, though not necessarily so, as *Plesianthropus VII* and *VIII* have relatively small temporal lobes. Finally, note may be taken of the horizontal orientation of the orbital margin in the *Plesianthropus VII* and *V* specimens, that of *Plesianthropus VIII* being again speculative.

CONCLUSION.

THE NEW DATA GARNERED from a study of the fossil endocasts have fortified the evidence that these *Australopithecidae* possessed brains significantly larger than those of the Anthropoid Apes, and definitely fashioned on Human lines. Though the Australopithecid brains reveal a measure of metrical and morphological variability, this fluctuation nevertheless permits the definition of a special brain which is neither Simian nor Human, and yet very close to the latter. There may be advantages in conceiving these *Australopithecidae* as Man-Apes; but as there are neural and collateral indications that these creatures walked erect, had achieved a measure of manual dexterity of the human type, and might have been capable of an organised system of vocal expression and thus of social organisation and communal life, they are clearly better defined as Pre-hominids or Proto-hominids.

FIGURE 1.

PLESIANTHROPUS TRANSVAALENSIS V & VII.

Norma lateralis: Natural size.

1: Sulcus subfrontalis; **2:** Sulcus Sylvii ramus anterior; **3:** Sulcus fronto-orbitalis; **4:** Sulcus frontalis inferior; **5, i:** Sulcus precentralis inferior; **5, s:** Sulcus precentralis superior; **7:** Sulcus frontalis medius; **8:** Intermediate fossette; **9:** Sulcus fronto-marginalis; **11:** Sulcus frontalis superior; **12:** Sulcus subcentralis; **13:** Sulcus diagonalis; **14:** Sulcus centralis Rolandi; **15, i:** Sulcus post-centralis inferior; **15, s:** Sulcus post-centralis superior; **16:** Sulcus intra-parietalis; **16, a:** Sulcus intra-parietalis anterior; **16, p:** Sulcus intra-parietalis posterior; **18:** Sulcus lunatus; **21:** Parieto-occipital fissure; **23:** Sulcus temporalis superior; **24:** Sulcus parallelus superior; **25:** Sulcus angularis; **26:** Sulcus occipitalis anterior. **R.A.:** Ramus anterior; **R.P.:** Ramus posterior (Middle meningeal artery), **P(a)1:** Superior anterior parietal meningeal artery; **P(a)2:** Inferior anterior parietal meningeal artery; **P(b):** Posterior parietal meningeal artery; **I.M.T.:** Intermediate temporal sulcus; **F.S.:** Sylvian Fissure; **S.S.:** Sigmoid Sinus; **T.S.:** Transverse Sinus; **M.O.:** Medulla oblongata; **R.:** Rostrum.

FIGURE 1.

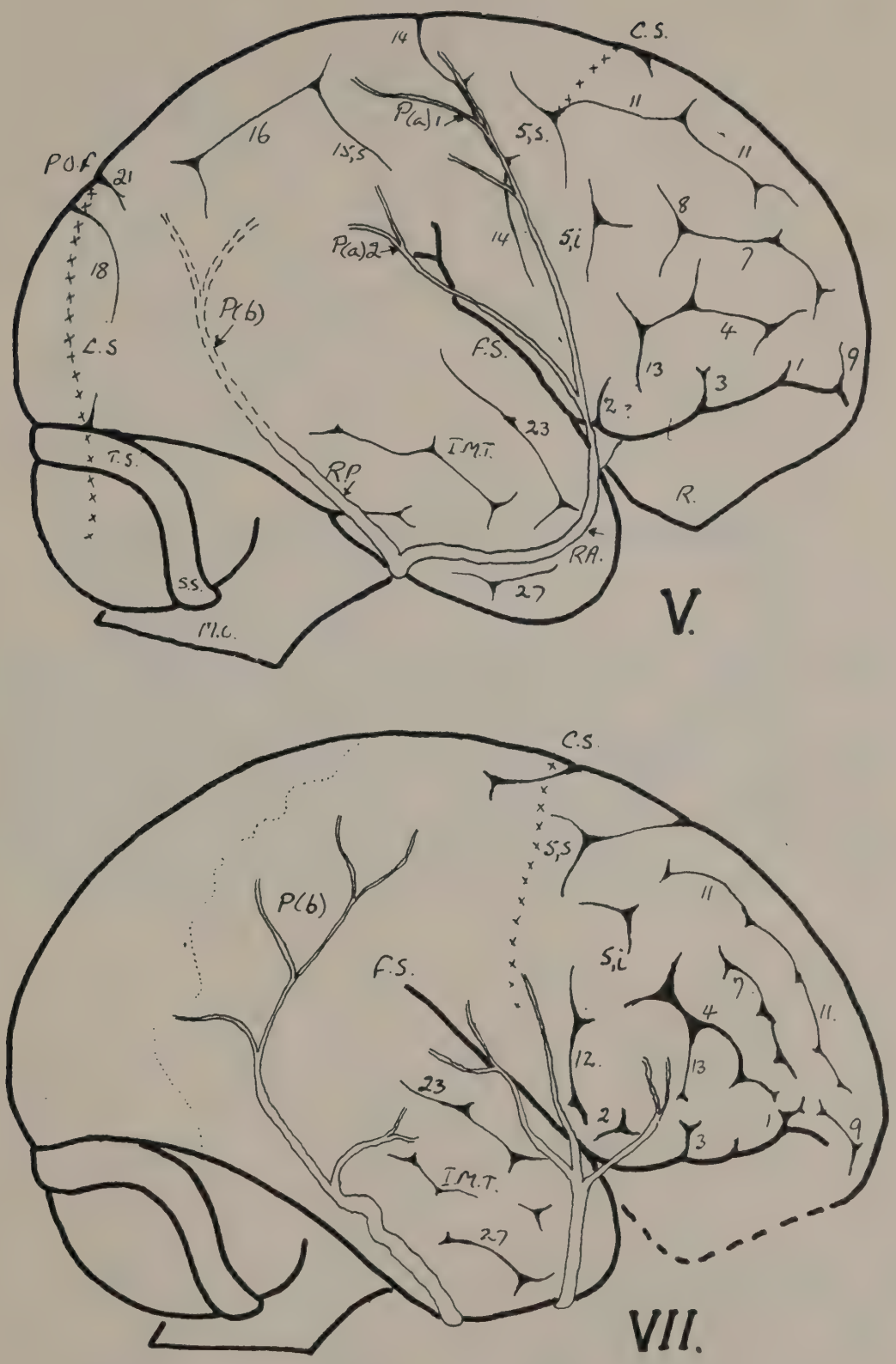

C.S.
14
11
P(a)1
5,s.
16
15,5
11
P.O.f
21
8
P(a)2
14
5,i
18
7
P(b)
4
C.S
F.S.
13
3
1
9
2?
23
T.S.
I.M.T.
R.P.
R.
RA.
27
S.S.
M.C.
V.
C.S.
5,s
P(b)
11
5,i
F.S.
7
4
11.
12.
13
23
2
3
1
9
I.M.T.
27
VII.

FIGURE 2.

PLESIANTHROPUS TRANSVAALENSIS V & VIII

Norma ventralis and Norma lateralis: Natural size.

T.L.: Temporal Lobe; **I.P.S.:** Inferior petrosal sinus; **C.A.:** Anterior part of Cerebellum; **C.P.:** Posterior part of cerebellar hemisphere; **T.S.:** Transverse sinus; **S.S.:** Sigmoid sinus; **M.M.A.:** Middle meningeal artery; **C.:** Carotid (at foramen lacerum); **G.G.:** Eminence of the gasserion ganglion; **Op.:** Ophthalmic division of the trigeminal nerve; **Mx.:** Maxillary division of the trigeminal nerve; **Mn.:** Mandibular division of the trigeminal nerve; **VIII:** Accoustic nerve; **XII:** Hypoglossal nerve (Impression of the hypoglossal canal); **P:** Pituitary. **S.t.m.:** Intermediate temporal sulcus; **O.L.:** Occipital lobe of cerebrum. **O.S.:** Orbital sulci. (Other abbreviations as for Figure 1).

FIGURE 2.

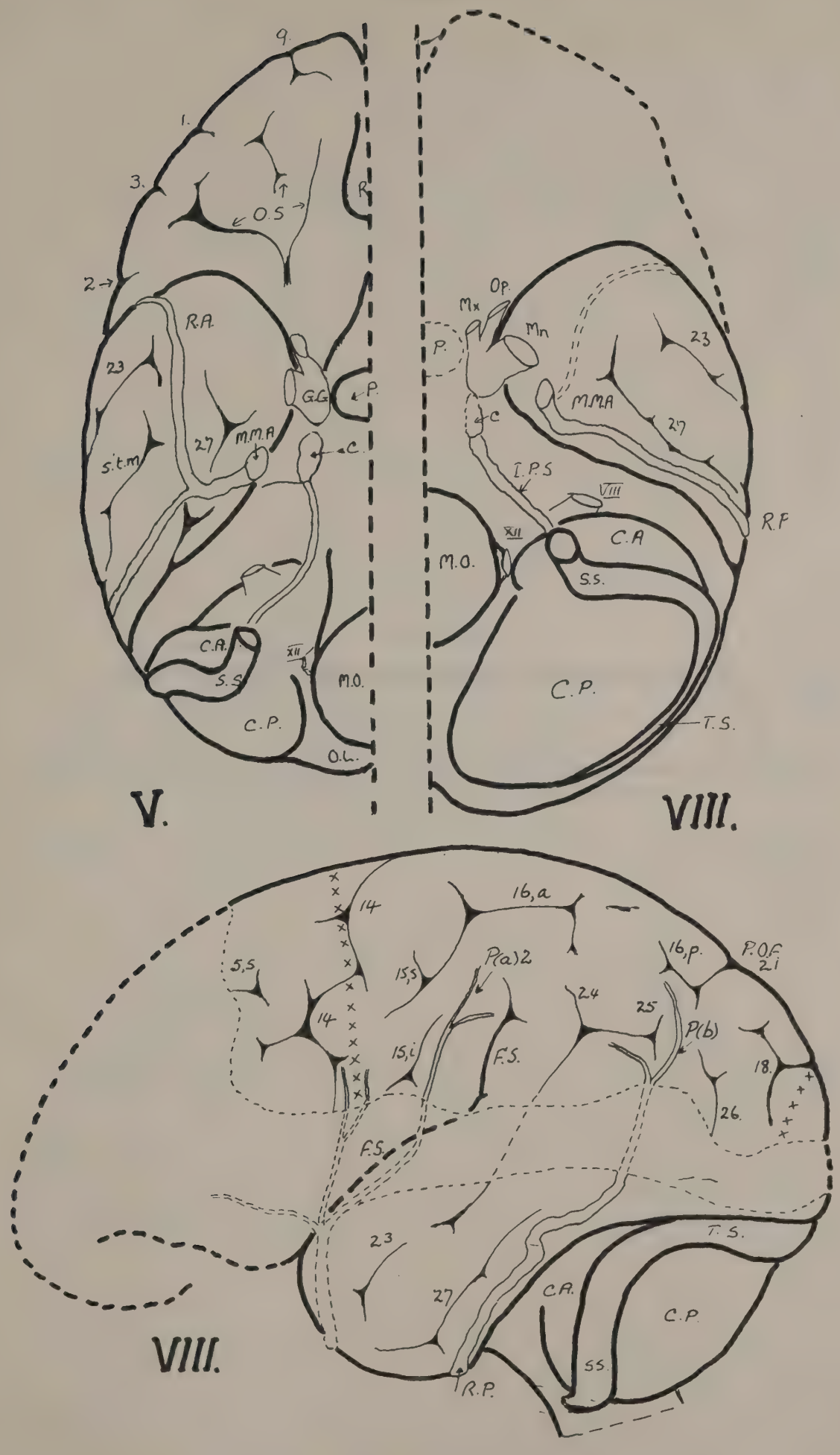

9.
1.
3.
O.S
R
2
R.A.
23
G.G.
P.
M.M.A.
27
C.
s.t.m.
C.A.
XII
S.S.
M.O.
C.P.
O.L.
V.
Op.
Mx
Mn
P.
23
M.M.A.
C.
27
I.P.S.
VIII
R.F.
XII
C.A.
M.O.
S.S.
C.P.
T.S.
VIII.
14
16,a
5,5
15,5
P(a)2
16,p.
P.O.F.
2,1
14
2,4
25
P(b)
15,i
F.S.
18.
26.
F.S.
T.S.
23
27
C.A.
C.P.
SS
R.P.

FIGURE 3.

PLESIANTHROPUS TRANSVAALENSIS V, VII & VIII.

Norma dorsalis: Natural size.

P.O.F.: Parieto-occipital Fissure; **L.S.:** Lambdoidal suture; **C.S.:** Coronal suture. (Other abbreviations as for Figure 1).

FIGURE 3.

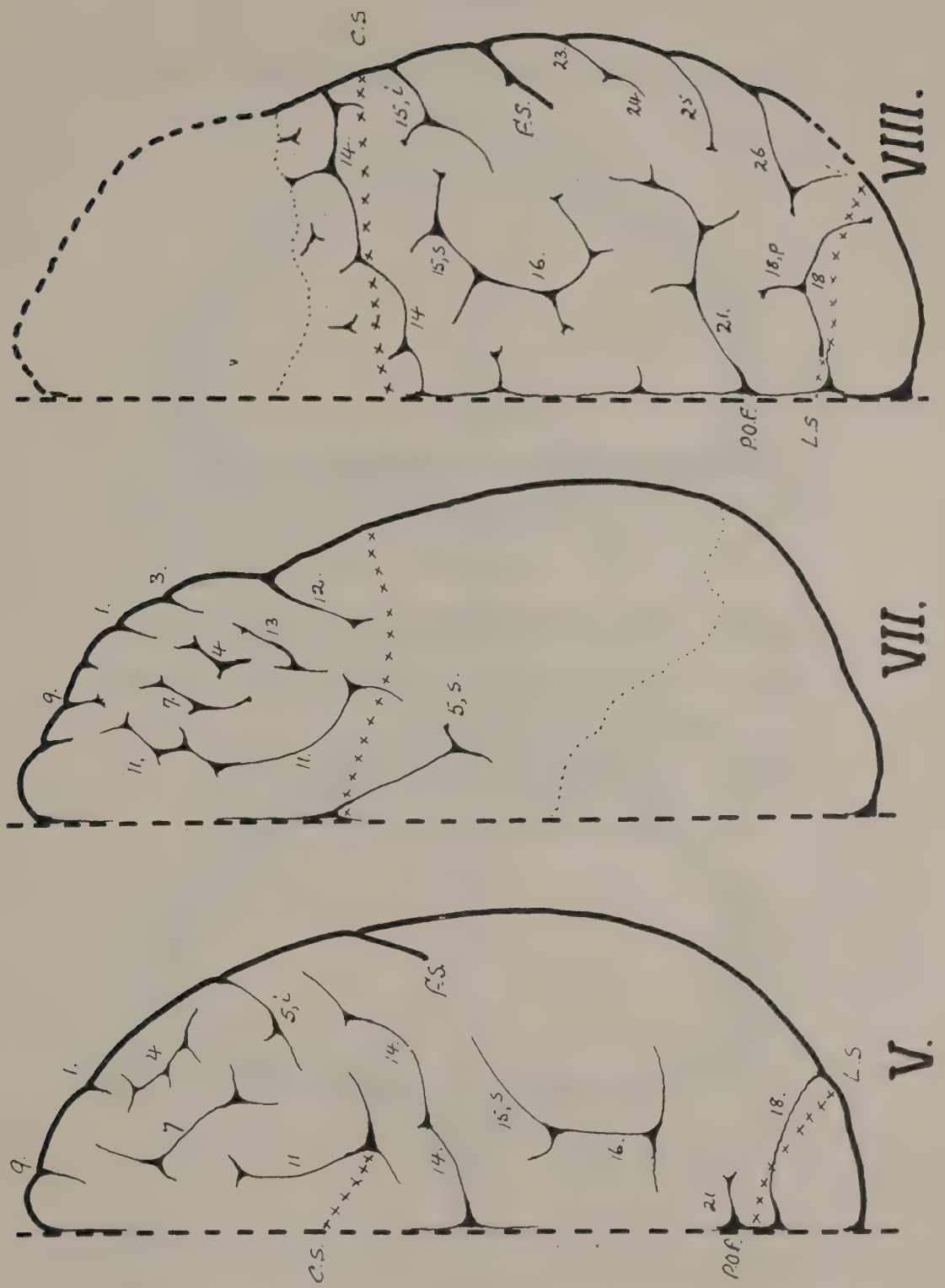

VIII.
C.S
14.
15,i.
F.S.
23
24.
25
26
14
15,s
16.
21.
18,p
18
P.O.F.
L.S
VII.
1.
3.
9.
11.
7
4
13
12.
11.
5,s.
V.
9
1.
4
7
11
C.S.
5,i
14.
F.S.
15,s
16.
21
P.O.F.
18.
L.S

FIGURE 4.

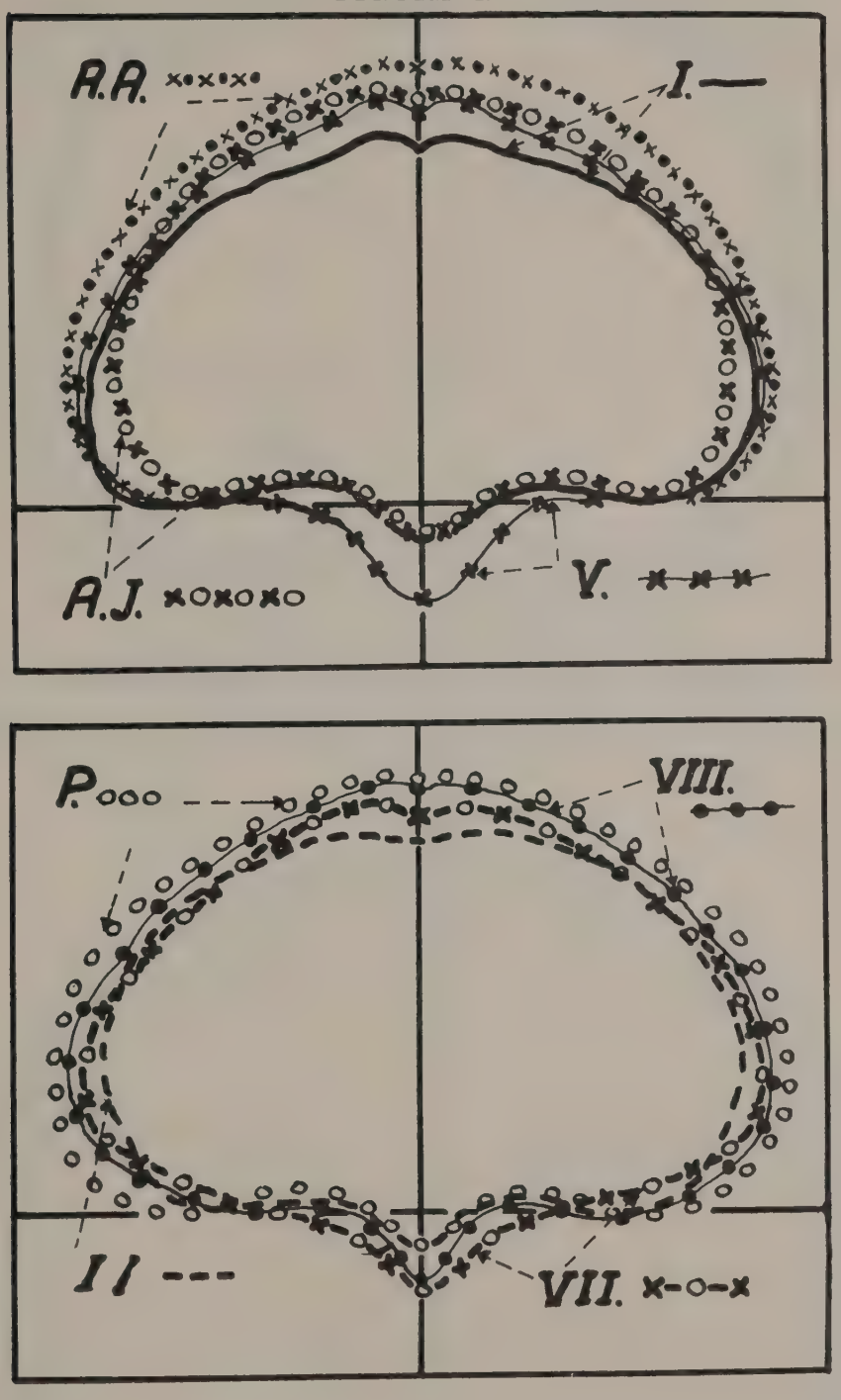
AUSTRALOPITHECID ENDOCRANIAL CASTS.

Superimposed Sectional Contours: Sylvian Coronal Plane.

Natural size.

A.A. ... Adult Australopithecus (Hypothetical).
A.J. ... Juvenile Australopithecus africanus.
I. ... ... Plesianthropus transvaalensis: Type or No. 1.
V. ... ... Plesianthropus transvaalensis No. 5.
P. ... ... Paranthropus robustus.
II. ... ... Plesianthropus transvaalensis No. 2.
VII. ... Plesianthropus transvaalensis No. 7.
VIII. ... Plesianthropus transvaalensis No. 8.

FIGURE 4.



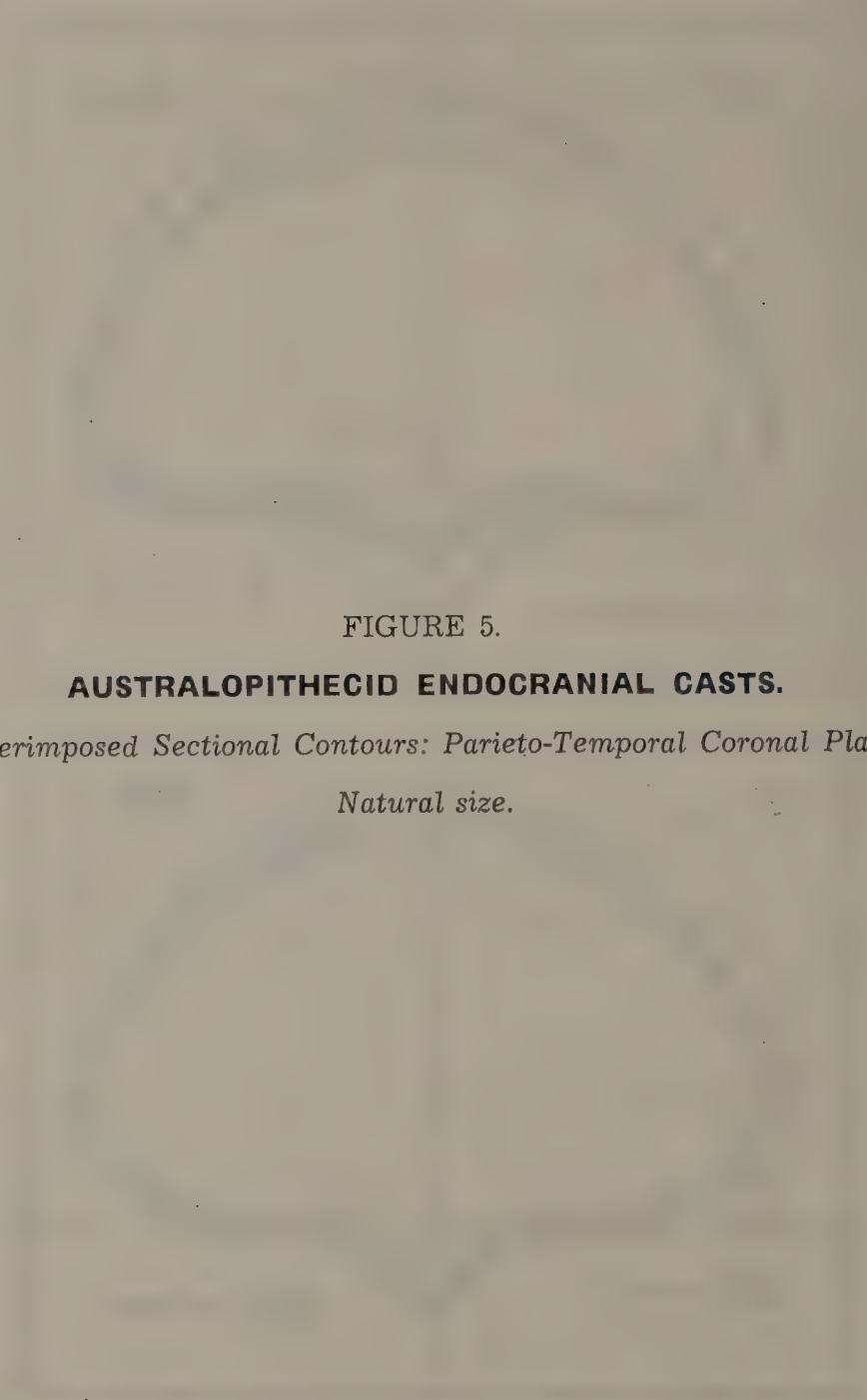


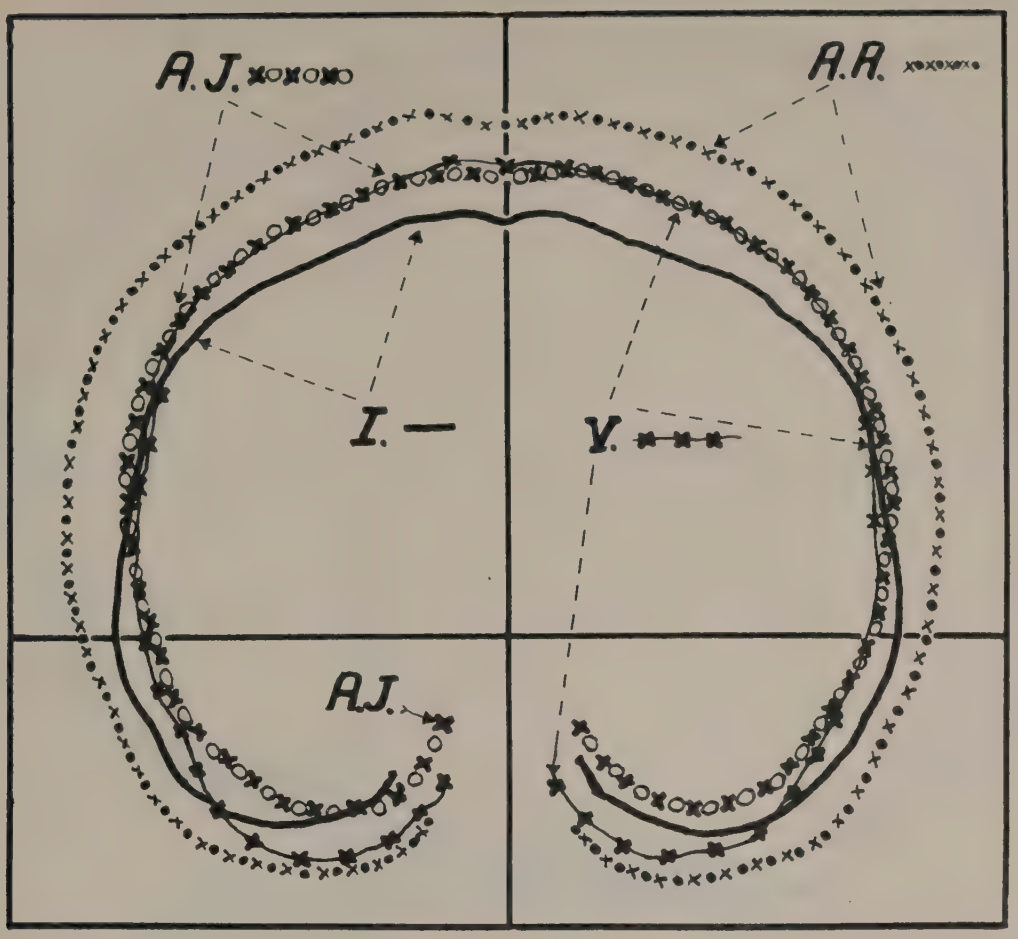
FIGURE 5.

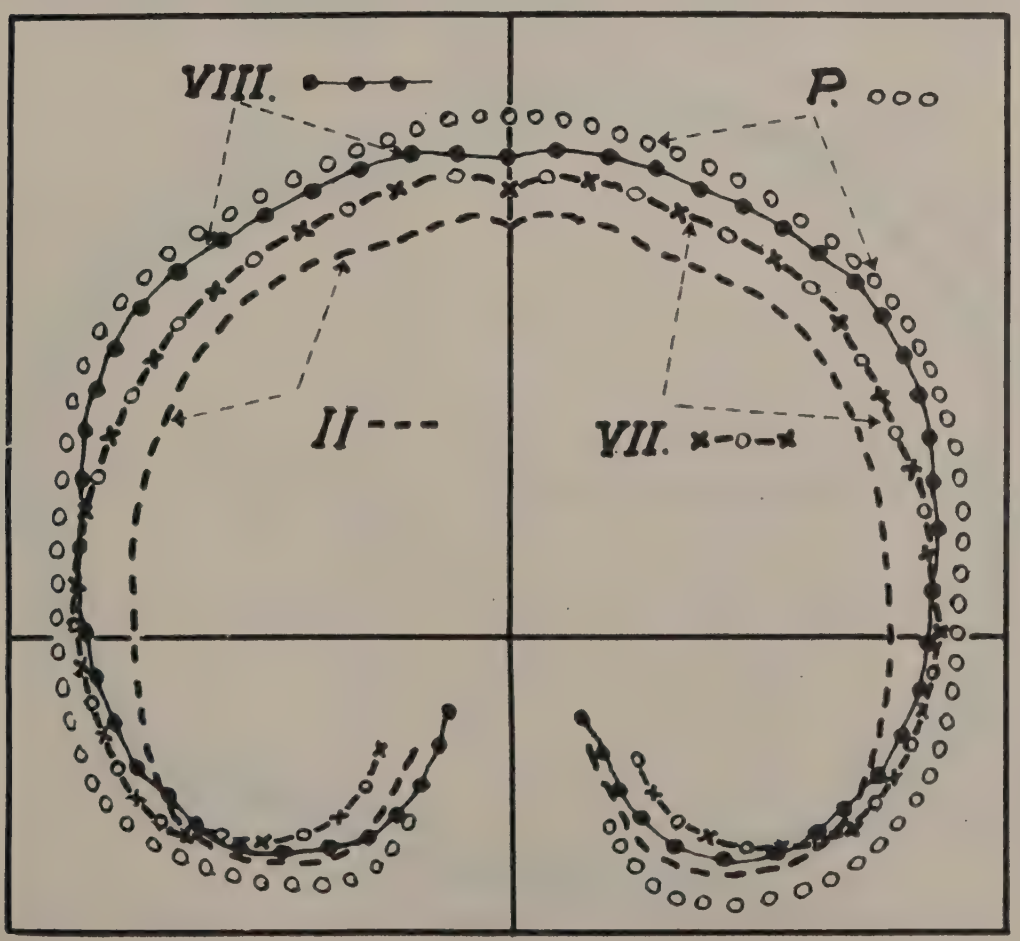
AUSTRALOPITHECID ENDOCRANIAL CASTS.

Superimposed Sectional Contours: Parieto-Temporal Coronal Plane.

Natural size.

FIGURE 5.





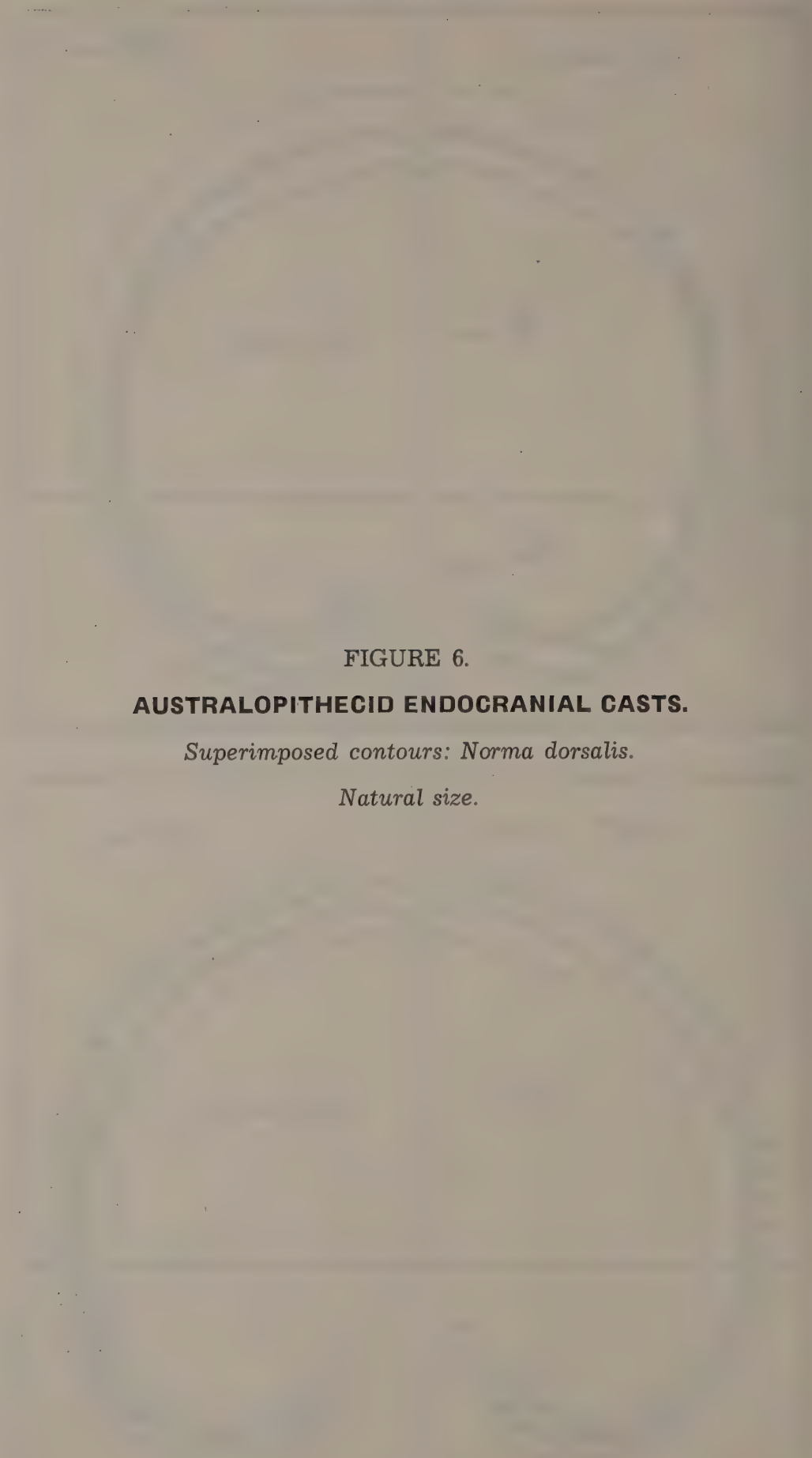


FIGURE 6.

AUSTRALOPITHECID ENDOCRANIAL CASTS.

Superimposed contours: Norma dorsalis.

Natural size.

FIGURE 6.

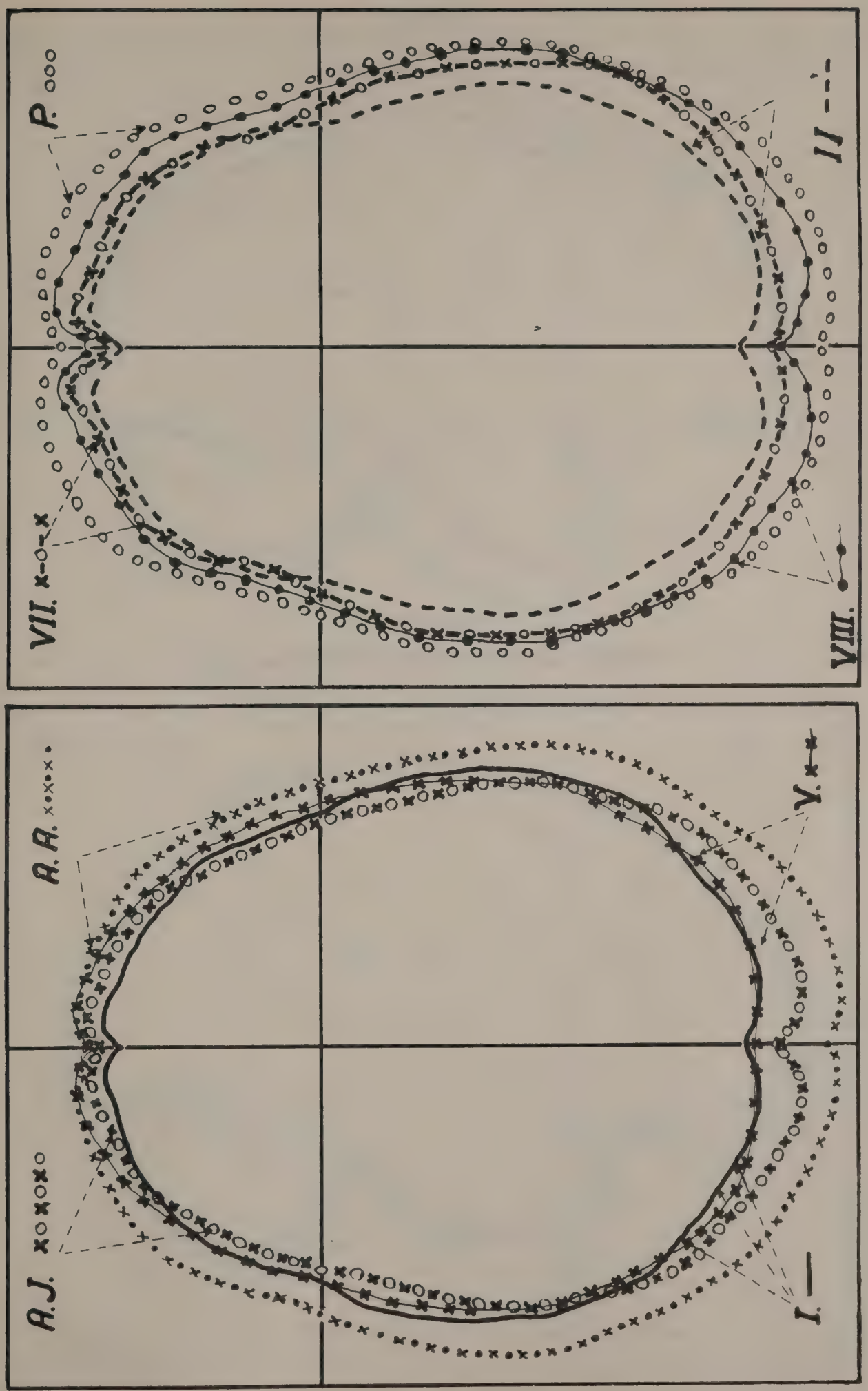


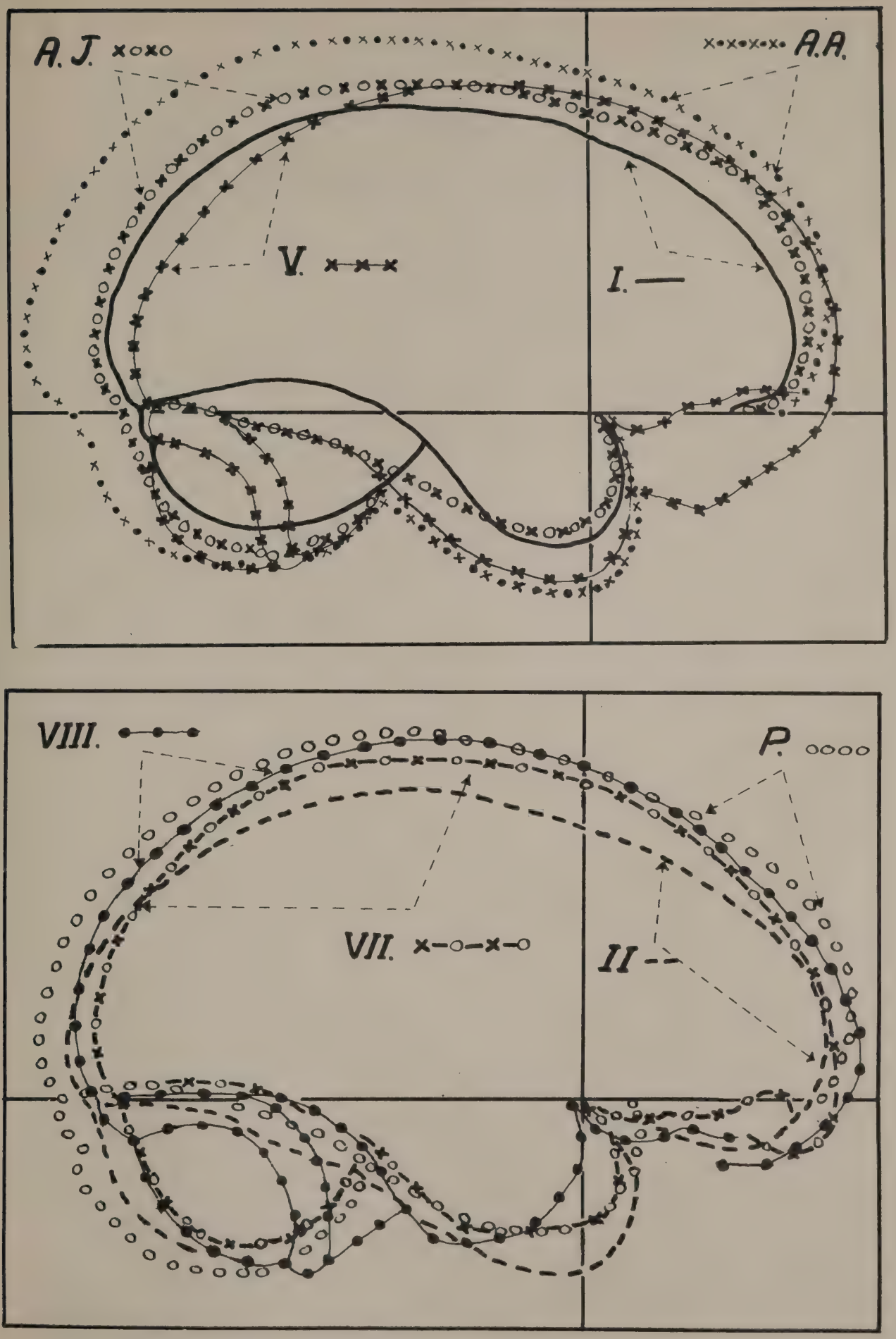
FIGURE 7.

AUSTRALOPITHECID ENDOCRANIAL CASTS.

Superimposed contours: Norma lateralis.

Natural size.

FIGURE 7.



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